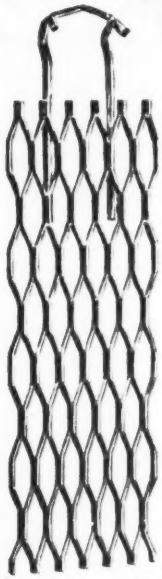
THE MONTHLY

Review

OCTOBER • • • 1946

CLEPANODES

TO SPEED ACTION AND IMPROVE EFFICIENCY OF ELECTROCLEANERS



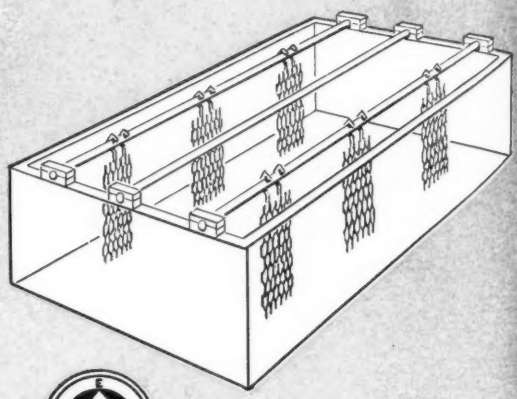
U. S. PAT. 2 275.194

The Clepanodes are made of Steel with Bronze Hooks. The design is of a special patented nature which gives improved current carrying capacity and increased gas dislodgement action.

The result is that more mechanical gas scrubbing action is obtained on the work being electrocleaned. Therefore the work will electroclean much faster and much more uniformly.

These Clepanodes are ideal for use in Electrocleaners prior to Bright Nickel Plating, Cadmium, Zinc, Brass, etc.

Install Clepanodes immediately in your Electrocleaning tanks.



CLEPANODES ARE AVAILABLE IN TWO SIZES

① 24" Grill + 4" Hook = 28" overall height, Total Net W. 12 lbs.

② 32" Grill + 4" Hook = 36" overall height, Total Net W. 16 lbs.

All Clepanodes are 8" overall in width.

CLEPANODES CLEANING COMPOUNDS

FREDERICK **GUMM** *Chemical Company Inc.*

538-542 Forest St., Kearny, N. J.

Here is help for you if you are

CHROMIUM PLATING

Automobile Hardware And Accessories Such as

BUMPERS
GAUGES
LOCKS
PISTON RINGS
LAMPS
TOOLS
HUBS
Etc.

Good results in chromium plating depend to an important degree on proper preparation of the base steel. Surfaces must be CHEMICALLY CLEAN in order to assure maximum deposit adhesion. You can be sure of the thoroughness of your preliminary surface cleaning process by following the example of many leading platers who use the fast-acting Oakite material especially designed for ANODIC degreasing . . .

OAKITE COMPOSITION No. 90

The highly effective wetting-out, emulsifying and penetrating properties of this material quickly remove insoluble smut, oil, grease, shop dirt and similar foreign matter. The resulting CHEMICALLY CLEAN surfaces provide uniform, durable chrome deposits on ferrous metals. For plating on non-ferrous metals equally effective Oakite materials are available. Complete technical data gladly supplied on request.

Put Oakite Technical Service To Work in Your Plant

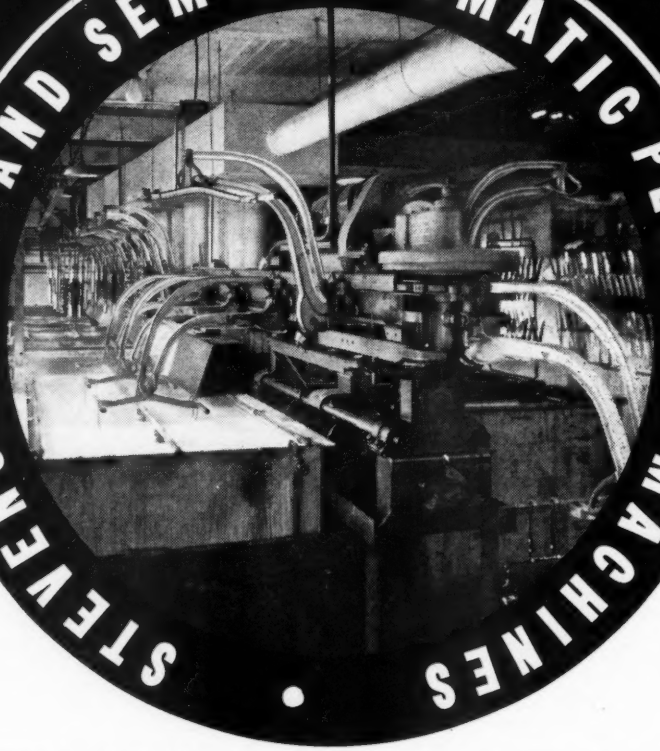
A 16-page booklet describing Oakite Composition No. 90 may be had FREE on request. In addition, the personal services of your nearby Oakite Technical Representative are available to you entirely without cost or obligation. Your inquiries are invited . . . promptly answered. Write TODAY!

OAKITE PRODUCTS, INC., 40 Thames St., NEW YORK 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**
MATERIALS · METHODS · SERVICE · FOR EVERY CLEANING REQUIREMENT

Industry's Finest

STEVENS FULL- AND SEMI-AUTOMATIC PLATING MACHINES



The performance of a machine in daily production determines whether or not it is properly designed and soundly engineered.

Stevens Full Automatic and Semi Automatic Plating, Cleaning and Pickling, Bright Dipping and Special Processing Machines have always met the most rigid requirements of the Plating Industry.

Today—with their several improvements and new developments—they are more than ever meeting the industry's most exacting needs.

The many nationally known organizations using Stevens Plating and Processing Equipment, are mute testimony to its dependability.

Any inquiry will receive careful consideration and study of individual requirements—at no cost or obligation.

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  - 2385 Dundas St. West, Toronto, Ontario

BUFFING COMPOSITIONS • METAL POLISHERS AND ELECTROPLATERS SUPPLIES-EQUIPMENT

THE MONTHLY

Review

VOLUME 33 • OCTOBER 1946 • NUMBER 10

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CONTENTS

Available Branch Speakers.....1039
BOWMAN, B. G., Magnetism and the Magnetic Thickness Gage.....1044
George Westinghouse, 1846-1914.....1048
MESLE, F. C., Silver Plating Bearings....1056
SERFASS, E. J. and LEVINE, W. S., A. E. S. Research Project No. 2, Determination of Impurities in Electroplating Solutions.....1073

DEPARTMENTS

Membership Report.....1089
Book Review.....1095
Abstract Section.....1096
Branch News.....1103
Patents.....1109
Industry News.....1112
Branch Directory and A. E. S. Officers Directory.....1121
Advertisers' Index.....1125

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50 cents per Copy

Entered as second class matter July 1, 1946, at the post office at Philadelphia, Pa., under Act of August 24, 1912.

WHY DU PONT

HIGH SPEED COPPER

GIVES

FASTER COPPER PLATING!

Du Pont monovalent solution cuts plating time in half.

Du Pont monovalent solution cuts plating time in half.

Here's what this process offers:

1. **SPEEDY PLATING**—at any given amperage, copper deposits *twice as fast* from Du Pont monovalent solution as from the usual bivalent solution. Standard text books show the following rates of deposition:

Copper (cuprous)-2.371g/amp./hr. • Copper (cupric) 1.186g/amp./hr.

2. **SMOOTH BRIGHT DEPOSITS**—uniform dense plate of commercial thickness can be obtained in a few minutes on steel and die castings.

3. **LOW OPERATING COSTS**—replenishment costs where suitable equipment is used may be unusually low; only from 5 to 10 lbs. of potassium cyanide or sodium cyanide per 5,000 gallons of solution per day!

4. **HIGH THROWING POWER**—superior throwing power of the cyanide solutions is a typical characteristic of this process.

5. **NO VENTILATION PROBLEM**—Potassium and sodium High Speed Copper Baths do not evolve poisonous or objectionable fumes.

This is the process for speedy, economical, smooth copper plating. Every day, in the many plants using this process, a total of about 500,000 intricately shaped die castings are given a jewelry-like finish—ready for direct plating of bright nickel and chromium. *Useful operating manual.* Send for your copy of "Potassium High Speed Copper Plating Process (RH-661)." Contains valuable information for copper platers.

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Chemicals · Processes · Service
for ELECTROPLATING

DU PONT
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

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Wilmington 98, Delaware

Please send manual for High Speed Copper Plating.

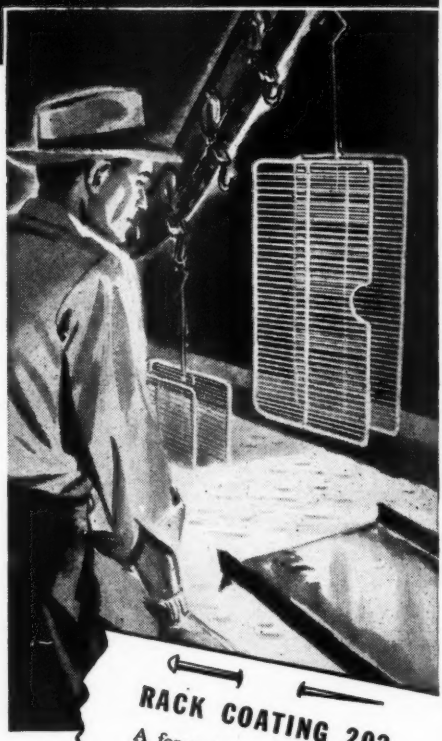
Name_____

Firm_____ Title_____

Address_____

A WHOLE YEAR OF TOUGH CLEANING CYCLES

. . . and Coating Still O K!



UNICHROME RACK COATING 203

The Air-drying Coating that Platers Prefer

A large metal-process plant reports that racks protected with Unichrome Coating 203 have given excellent service through an entire year of severe cleaning cycles. Service records like this show why so many plating-room foremen and superintendents prefer Coating 203 for all of their air-drying rack coating requirements.

This coating has excellent adhesion for all plating cycles such as chromium, nickel, copper, zinc, and cadmium. It's easy to apply—simply dip the rack in the convenient open-end drum and hang it up to dry. Tough and flexible, it stands plenty of rough handling and cuts cleanly at contacts. Write today for prices and data.

RACK COATING 202

A force-drying coating that provides the *extra* adherence necessary for the most severe cycles, such as anodizing and hot alkaline cyanide solutions.

UNICHROME

PROCESSES AND MATERIALS FOR SURFACES THAT SURVIVE

Chromium Plating · Porous Chromium · Unichrome* Copper · Unichrome Lacquers · Ucilon* Protective Coatings · Unichrome Stop-Off Lacquers and Compounds · Unichrome Dips · Unichrome Rack Coatings · Anozinc* Compounds · Unichrome Strip

*Trade Mark Reg. U S. Pat. Off.

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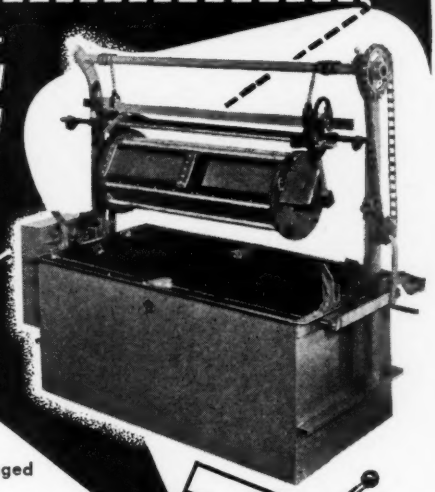
GET ALL THESE ADVANTAGES

Lasalco's Richards Barrel Plater Makes Speed Plating More Profitable!



★ Negative contact can be arranged to carry up to 800 amps.

★ Heavy, flexible dangler imbedded in load gives perfect contact.

★ Easily, quickly cleaned negative connection, separated from hanger arms, brought direct to work through hollow hub.

★ Selective 3-speed drive.

★ Anode rods, conductors, connections and switches are completely insulated from tank.

★ Cylinder when lowered goes automatically into exact position thus engaging driving gears and electrical contact without operator's attention.

★ Cylinder construction of 5/16″ laminated canvas Bakelite or 3/8″ hard bronze rubber (as illustrated). Special rod or woven types also available.

★ Sizes, 12″ (across flats) by 24″, 30″, 36″ and 42″ long for 24, 30, 36, or 42 qt. loads.

★ Gear or sheave drive.

★ Hand or tackle hoist. Ratchet device holds cylinder in any desired position.

★ Effortless, speedy raising, loading, lowering or unloading.

★ Nothing plates but the load.

If you want speed *plus* economy, get a Lasalco Richards Barrel Plater.

Write today for complete information

LASALCO, INC.

2818-30 LA SALLE STREET ST. LOUIS 4, MISSOURI

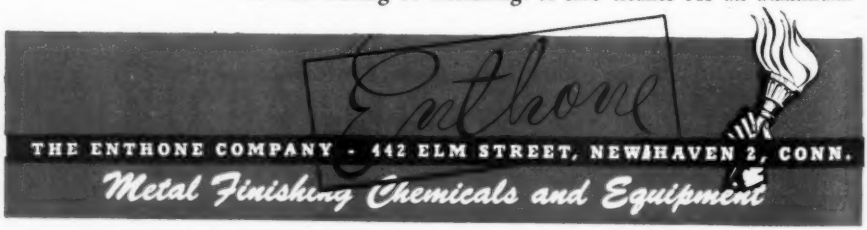
NEW PRODUCTS for finishing ALUMINUM

ALUMOX A process for passivating aluminum alloys to resist salt spray and to form a base for organic finishing. The Alumox finish itself is a pleasing grey-green.

ALUMON A process for electroplating upon aluminum. By means of the Alumon dip, aluminum alloys can be prepared for copper, silver, or cadmium plating.

CLEANER-E An etching type aluminum cleaner that gives a fine, beautiful controlled etch finish. An ideal cleaner for preparing aluminum for painting, plating or anodizing.

CLEANER-NE A non-etching type alkali aluminum cleaner for degreasing buffed or bright aluminum alloys without etching or tarnishing. A safe cleaner for all aluminum.



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FULL AUTOMATIC MACHINES

for

Plating • Cleaning • Processing

Adaptable to Any Operating Sequence

Simple in design and heavily constructed to operate continuously without excessive maintenance.

●

Meaker Process Lines for Electrogalvanizing Wire and Strip Steel

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THE MEAKER COMPANY

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Detroit Distributor:
GEORGE L. NANKERVIS CO.

NANKERVIS

Announces

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Improved Compound Applicator. Total weight 20 pounds, completely installed at any angle on any type automatic, either as single unit or in stages.

14 strokes per minute.

10 adjustments of feed. Motor Driven.

110 volt, 220 volt or 440 volt.

Nankervis applicators are now in operation in many plants doing everything from simple to complex multiple buffing operations.

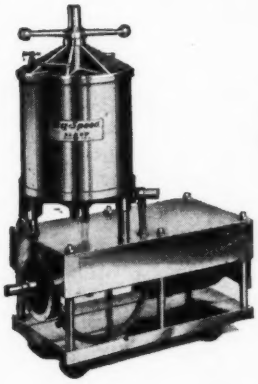
•

Write today for detailed bulletin.

GEORGE L. NANKERVIS COMPANY

5442 Second Blvd., Detroit 2, Michigan

COMPLETE METAL FINISHING EQUIPMENT

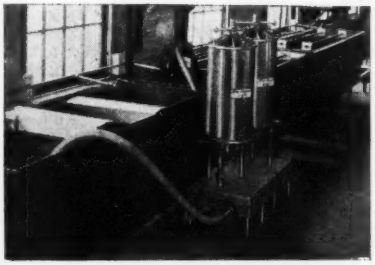


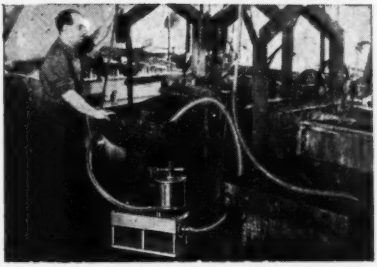
Tested! Proved!

ALSOP FILTERS

mean

finer finished surfaces
elimination of rejects
low production cost





You can have positive, trouble-free plating. Just write for details or contact your regular plating supplier.

Alsop Filters of many sizes and capacities, for practically every type of plating installation—are meeting specific filter requirements in thousands of plating rooms, large and small. The construction provides every advantage for obtaining finer finished surfaces and at low cost.

On continuously filtering large tanks or for the quick filtering of small tanks the sealed feature, eliminating loss through leakage or dripping, is a deciding factor.

In the barrel plating process, a 300-gallon per hour filter, complete with electric pump occupying only 9″ x 20″ of floor space, keeps the solution brilliantly clear.

The amazingly high capacity and filtering speed of the "*Sealed-Disc*" Filter is a distinct advantage in producing more perfectly finished work in less time on any plating installation. Extra equipment such as mixing tanks are not required because filter aids are not usually necessary.

ALSOP
ENGINEERING CORPORATION
Filters · Filter Discs & Sheets · Mixers · Agitators
110 Fine Street, Milldale, Connecticut

the power you want... when you want it!

to meet varying demands of plating and anodizing

G-E COPPER-OXIDE RECTIFIERS

offer quick power change-over . .

There's no need to be tied down by a fixed power supply. The flexibility of General Electric copper-oxide rectifiers offers you a wide choice of current and capacity to meet the requirements of various types of plating. You can easily install one or more G-E units without special foundations or expensive accessories. Others can be added as needed. With G-E rectifying equipment, you have "building block" changeability for series, parallel, series-parallel circuit arrangements.

Basically a step-down transformer and a rectifier, each self-contained G-E unit supplies smooth, steady d-c in blocks of 6 or 12 volts. Control is manual or automatic. With the automatic control, voltage is maintained at within plus or minus one per cent from no-load to full-load. Adjustment is controlled at a-c input for economy.

There are many G-E combinations designed and engineered to meet the most exacting plating and anodizing conditions. For information and illustrated booklet, write Section A30-10106, Appliance and Merchandise Dept., General Electric Company, Bridgeport 2, Connecticut.

GENERAL ELECTRIC

PARTLY CLEAN IS POOR ECONOMY

Well-groomed people instinctively avoid a poorly-groomed store. Likewise, careful electroplaters instinctively do not put scrupulously pre-cleaned work into an impure plating bath.

Impurities in the plating bath quickly foul the freshly cleaned surfaces of objects to be plated. It's poor economy to spend time and money on alkali and electrolytic cleaning, and then to put the clean work into a bath which nullifies such effort.

Darco S-51 activated carbon completely removes grease, oil, soap, colloids and other trouble-making impurities from plating solutions. Do a complete job of cleaning—clean the plating bath as well as the work you put into it.

Darco S-51 is being used regularly on bright and dull nickel, zinc, cadmium, silver, copper, rhodium, tin, and gold solutions. It has no harmful effect on these metals themselves—and a few cents' worth purifies 100 gallons of solution for a week.

●

(This trademark identifies the genuine. Accept no packages without it.)

DARCO

DARCO CORPORATION

60 E. 42nd Street, New York 17, N. Y.

Is Your Plating Bath as Clean as the Water Used in Your Final Rinse?

DARCO—REG. U. S. PAT. OFF.

HOW TO BEAT THE GLUE SHORTAGE

. . . and step up your polishers' production, too!

HERE IS one shortage that actually can give your production a *lift!* It's easy: Take the bull by the horns. Say goodbye to glue. Switch to new, modern GRIPMASTER—the amazing, "years-ahead" polishing wheel cement that boosts polishers' production an average of *47% more* pieces per head! GRIPMASTER contains a secret new high heat resisting ingredient. It does not "glaze" on the wheel. *One* grade grips *all* grains—250 to 20. Greatly expanded manufacturing facilities guarantee *immediate* shipment.

GENEROUS FREE SAMPLE

IMMEDIATE SHIPMENT!

GRIPMASTER PAT. PEND. POLISHING WHEEL CEMENT

A few jobber territories still available.

GRIPMASTER DIVISION
Nelson Chemicals Corporation
(formerly Michigan Bleach & Chemical Co.)
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IN CANADA:
Nelson Chemical Co.
Windsor, Ontario

Please send us a generous free sample of Gripmaster.

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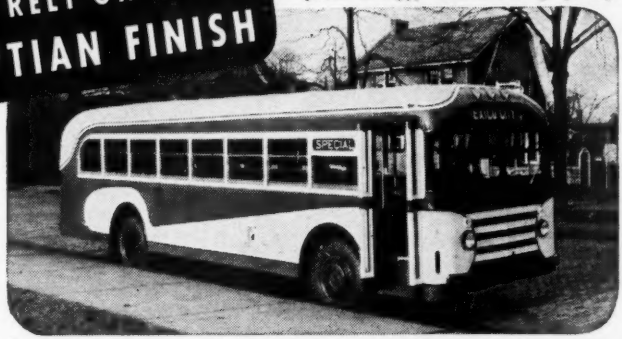
ATTENTION_____
ADDRESS_____
CITY_____ STATE_____

Wisely...

BEAVER METROPOLITAN COACHES RELY ON EGYPTIAN FINISH

Above — Beaver Metropolitan writes: "This coach, Egyptian-finished ten years ago, still in service and never refinished, looks as good today as when it left our shop".

Below — "Our late B-35 PT37 passenger coach. Of course this is also finished with Egyptian Lacquer". Here is pictured proof of Egyptian's enduring quality.



In modern transportation long-lasting good looks are an important economy. So is the long lasting protection which high quality finish affords. The eminence of EGYPTIAN finishes in the transportation field—in all fields where finish is important — is eloquent endorsement of the high quality standards which EGYPTIAN steadily has maintained through the years.

We invite your inquiry with regard to any finish problems.

THE EGYPTIAN LACQUER MANUFACTURING COMPANY

SPECIALIZED PRODUCTION FINISHES

P. O. BOX 444, NEWARK, N. J.

PENTRATE PENTRATE PENTRATE PENTRATE PENTRATE

THE NEW MONITOR SWEEPER

Manufactured by WHITE AIRCRAFT CORP., Palmer, Mass.

with **BLACK** *by Pentrate*

This sleek new MONITOR Sweeper is finished in bright blues and reds accentuated by lustrous Pentrate black. Pentrate can't crack, chip, peel or rub off. And because it imparts durability and protection as well as appearance, the inside working parts of the MONITOR have been Pentrated too! Look at your own product. If a deep, rich black, either as a basic color or as trim, would add that sales-appealing punch, write for further information.

HEATBATH CORPORATION

SPRINGFIELD 1, MASSACHUSETTS

In Canada — WILLIAM J. MICHAUD CO. LTD. — Montreal

PENTRATE PENTRATE PENTRATE PENTRATE PENTRATE

RELIANCE
VARIABLE SPEED
LATHES

Reliance Variable Speed Lathes Cut Costs

There is a RELIANCE LATHE for every need.

Let us quote on your requirements.

Chas. F. L'Hommedieu & Sons Co.

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Complete Plating Plants Installed

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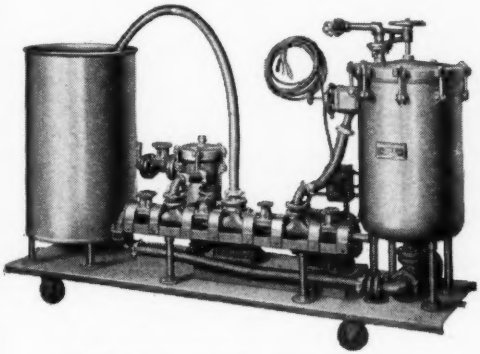
You can depend absolutely on
McGEAN
ANODES and CHEMICALS
ALWAYS HIGHEST COMMERCIAL QUALITY
FOR RELIABLE, SATISFACTORY PLATING PERFORMANCE
THE McGEAN CHEMICAL COMPANY
CLEVELAND 15, OHIO

FOR GREATER *Efficiency* AND *Economy*

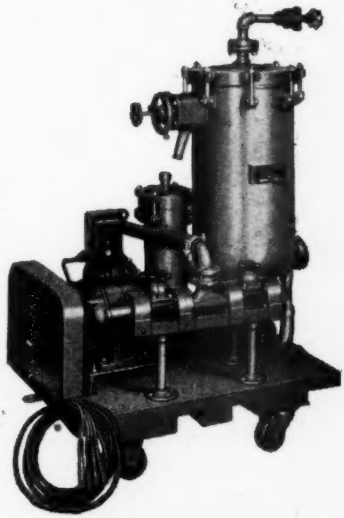
INSTALL MODERN INDUSTRIAL FILTERS IN YOUR PLATING PLANT

You can keep your plating plant operating at top efficiency only if you have adequate filtration. Industrial filter systems are designed and built to provide continuous high speed filtration and circulation.

Industrial Filters equipped with the AIRWASH cleaning feature have been in continuous use for months without opening the filters or removing the plates. Air agitation quickly dislodges the accumulated sludge and leaves the filter clean and ready for a new filter cycle. Many hours of production time are saved thus lowering your operating costs.



No. 1—Filter shown is equipped with slurry tank with double suction and discharge control providing an ideal continuous filtration system.



No. 2—A typical portable filter as constructed for bright nickel, acid copper and other acid type bath. Used for either intermittent or continuous filtration.

Other Products

Salt Fog Corrosion Test Equipment

Centrifugal Pumps of Duriron, Worthite, Stainless Steel, Hard Lead, Bronze and Iron.

In Stock

Filterbestos

Activated Clay

Activated Carbon

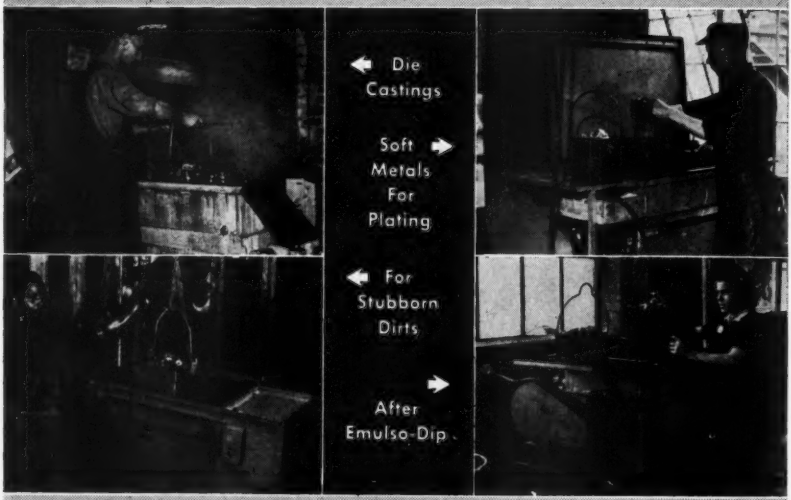
Filter Powder in all grades

Prompt shipment

INDUSTRIAL FILTER & PUMP MFG. CO.

1621-39 WEST CARROLL AVENUE **CHICAGO 12, ILLINOIS**

The Cleaning MACHINE is as Important as the CLEANER!



MAGNUS AJA-DIP CLEANING MACHINE

(Patented)

Ask for as many copies of the new bulletin, "Metal Cleaning With Agitation," as you can use. It will show you how to boost production, get better cleaning and cut overall cleaning costs.

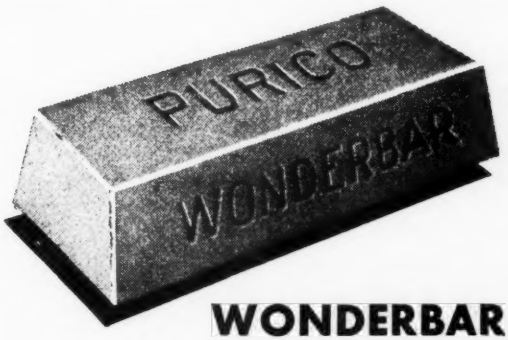
THE chemical cleaning action of the right cleaner is only part of the story in *fast, thorough, low cost cleaning.* That's why you should investigate the MAGNUS AJA-DIP CLEANING MACHINE...the pioneer equipment in providing effective *mechanical* cleaning action.

1921-1946 TWENTY-FIVE YEARS OF SERVICE

MAGNUS

MAGNUS CHEMICAL COMPANY
41 SOUTH AVENUE, GARWOOD, N. J.

Cleaners • Machines



WONDERBAR

PURICO WONDERBAR is a buffing composition developed by THE PURITAN MANUFACTURING COMPANY to reduce time and cost spent on buffing. This patented pre-saponified Tripoli bar composition leaves less residue after buffing . . . requires simple rinsing . . . eliminates difficult manual scrubbing from intricate patterns.

PURICO API INHIBITOR

For quick action, highly effective! Added to acid, it descales . . . cleans . . . inhibits attack on iron and steel . . . leaves base metal free from embrittlement.

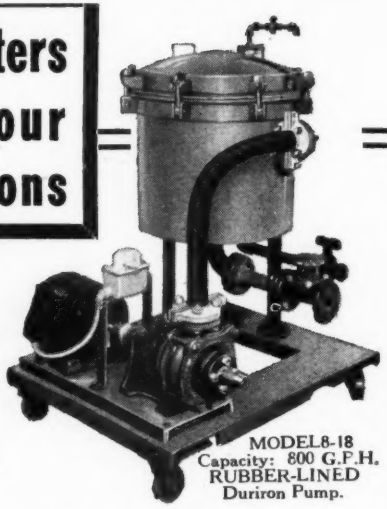
PURICO ZN

Provides lustrous, long lasting finish on zinc products. This black oxide finish penetrates the metal directly . . . eliminates the danger of chipping or flaking off.

Start with a Good Finish

THE *Puritan*
MANUFACTURING COMPANY
WATERBURY, CONNECTICUT

Now! special filters designed for your plating solutions



MODEL 8-18
Capacity: 800 G.P.H.
RUBBER-LINED
Duriron Pump.

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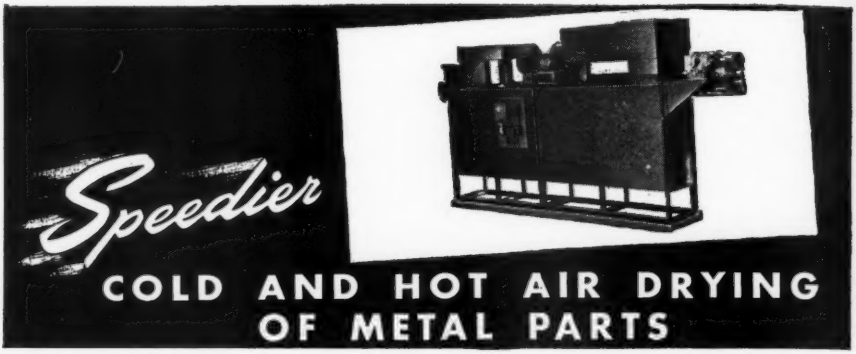
(*Continued on Page 1068*)



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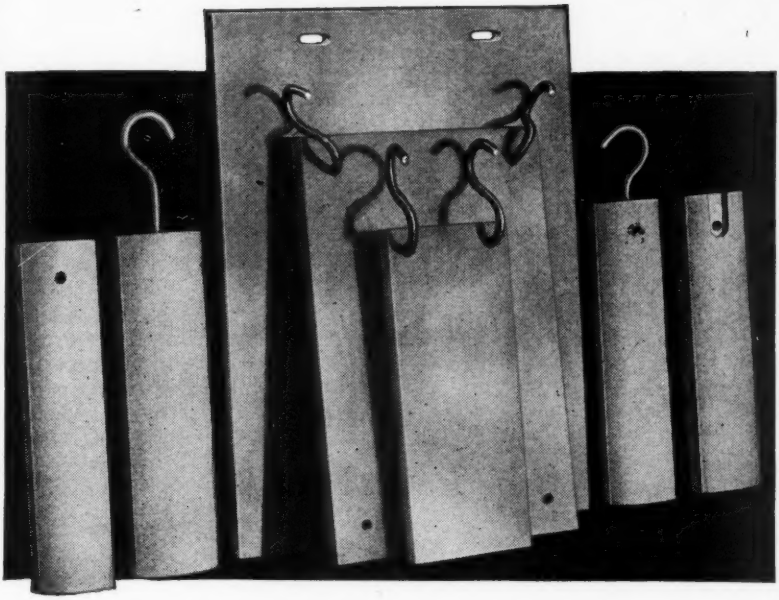

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MAGNETISM AND THE MAGNETIC THICKNESS GAGE

BY B. G. BOWMAN

STANDARD STEEL SPRING CO. — CORAOPOLIS, PA.

In the preparation of nickel plated panels of S.A.E. 1085 steel for outdoor exposure test, it was necessary to calibrate the magnetic gage employed in the determination of nickel thickness. Several panels with substantially uniform nickel deposit of definite thickness were submitted to the laboratory for this purpose. It was found that magnetic gage readings increased from one end of the panel to the other, the center values being intermediate and usually close to the average for the entire plate. Since these observations could not be explained by differences in current distribution during plating, one was lead to suspect that magnetism of the steel might be the cause.

It is known that S.A.E. 1085 steel may become highly magnetic during polishing and plating. The degree of magnetization and the extent to which it would influence the magnetic gage readings had to be investigated.

Procedure

To determine the degree of magnetization of a plate, a compass A was placed on a table as shown in Figure 1 so that it registered directly north and south corresponding to the line N.S. A line E.W. was drawn on the table at right angle to N.S. and passing through the center of compass A. The plate B to be tested was placed with its long center line coinciding with the line E.W. and thus in the same horizontal plane as compass A. The plate B was then moved along line E.W. towards compass A until any desired deflection of the compass was obtained. The distance from the top edge of plate B to the line N.S. was measured in centimeters. For a given deflection of the compass, the distance would be greater, the higher the degree of magnetization of the plate being tested.

Results

A 45° deflection was chosen as a basis for the first measurements. A plate as received gave a 45° deflection at a distance of 15.4 cm, as shown in the second column of Table I. The plate was then partially demagnetized by passing it through a solenoid so that a 45° deflection was obtained at a distance of only 5.7 cm. The magnetic gage readings were then taken as recorded in the third column of Table 1. This procedure was repeated for deflections of 15° and 0° at a distance of 3 cm and readings were obtained as recorded in the fourth and fifth columns of Table I.

All plates were 4 x 6 inches and $\frac{1}{8}$ inch thick. The magnetic gage readings shown in Table I were taken at numbered locations 1 to 9 as given in the first column of Table I and shown in Figure 2. A margin of $\frac{1}{2}$ inch from the edges of the plate was disregarded. The actual thickness was determined by stripping and analysis of the coatings at locations 1, 3, 5, 7 and 9 as shown by squares in Figure 2. These thickness values are recorded in the last column of Table I.

Discussion

It should be noted that the gage readings for the greatest degree of magnetization in the second column of Table I average 90 corresponding to 1.0 mil average thickness. The readings at the top and bottom of the plate are above and below the center values respectively indicating a polarity effect on the magnetic gage.

As the degree of magnetization is reduced corresponding to the date in Columns 3 to 5 of Table I, the variations in the readings are largely eliminated even though the average value for the plate has not changed.

(*Continued on Page 1092*)

TABLE I

EFFECT OF MAGNETISM ON MAGNETIC GAGE READINGS ON NICKEL PLATED S.A.E. 1085 STEEL

	DEGREE OF MAGNETIZATION				
Magnet deflection	45°	45°	15°	0°	Actual thickness mil
Distance of plate in cm	15.4	5.7	3.0	3.0	
Location*	MAGNETIC GAGE READINGS				
1. Top	105	92	92	92	1.00
2. Top	105	91	93	90	....
3. Top	109	93	94	90	1.00
4. Center	95	92	92	92	....
5. Center	90	95	94	94	0.96
6. Center	86	91	93	92	....
7. Bottom	76	89	85	86	0.89
8. Bottom	68	86	84	85	....
9. Bottom	72	85	86	86	0.91
Average	90 = 1.0 mil	90 = 1.0 mil	90 = 1.0 mil	90 = 1.0 mil	0.95
Extreme deviation from average	+15 = +0.17 mil −22 = −0.24 mil	+5 = +0.56 mil −5 = −0.24 mil	+4 = 0.045 mil −6 = 0.067 mil	+4 = 0.045 mil −5 = 0.056 mil	+0.05 −0.06

*See Fig. 2

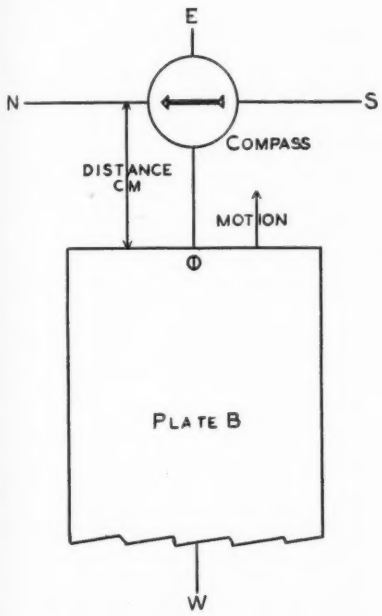

Fig. 1. Test Arrangement viewed from above

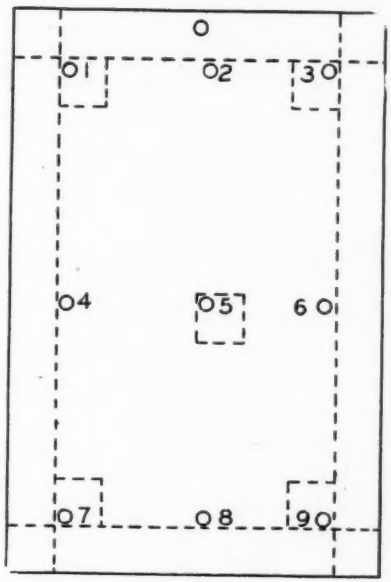

Fig. 2. Test Locations on specimens

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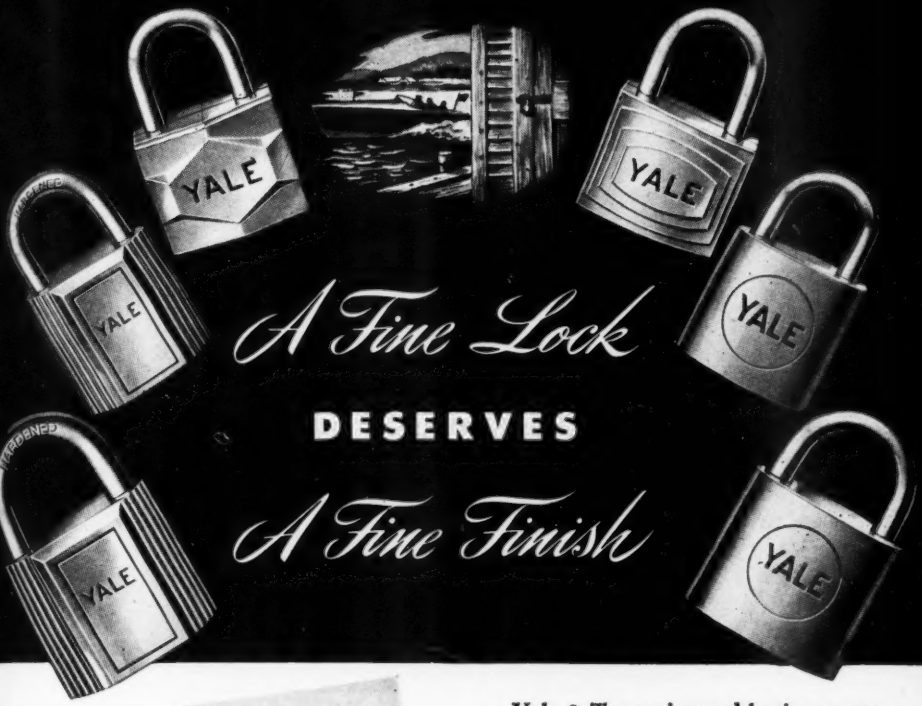

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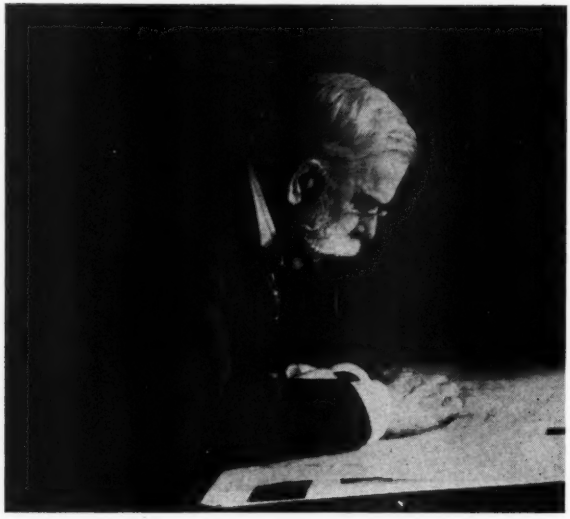


From a biography published by Westinghouse Electric Corporation in celebration of the centennial of the birth of the great inventor.

In the years between the end of the Civil War and World War I, the industrial revolution in America had its greatest and fullest development. It was during that half century that the foundations for the modern industrial age were laid, and it was during that period that George Westinghouse made his great contributions.

Born on October 6, 1846, George Westinghouse received his first patent in 1865, three weeks after his nineteenth birthday and six months after Lee's surrender at Appomattox. His last patent was issued in 1918, four years after his death and less than a week before the Armistice. Between those two patents were 359 others, many of them revolutionary in principle. They were the monumental expression of a creative genius who responded to a growing America with a complete understanding of the time and far-reaching, practical ideas to meet its need.

His inventions hastened the growth of railroads when they were becoming the economical lifeline of the nation. He devised the first effective means for stopping trains—the air brake; he pioneered in the development of railway signals and interlocking switches; he invented a safe and efficient mechanism for joining railway cars; he brought out the first main-line electric locomotive and was a pace-maker in modern railway electrification.

When the nation's industries needed power, he developed a system for transmitting and using natural gas, and topped this with perhaps his greatest contribution of all—today's alternating current system of generating, transmitting and utilizing electricity for power and light.

To modern world commerce he gave a perfected steam turbine geared to drive ships, and with this paved the way for the development of powerful persent-day fleets.

Westinghouse was not only an inventor—he built what he invented. In the course of his career, he formed and directed more

than sixty companies to implement his ideas, and the impact of his leadership radically changed the course of industrial history.

Today—one hundred years after his birth—scarcely a man lives in America whose life and activities have not been affected by what George Westinghouse did. His work is part of the very structure of the nation's power systems, of its industry, and of every modern form of transportation.

Today we take power for granted. A flip of a switch turns on a lamp or a vacuum cleaner, or sets a giant machine in operation. We seldom think twice of the source because we have learned to rely on electricity as a swift, clean, always obedient servant. In the early 1880's, however, electricity was just beginning to show promise as a power source. Its usefulness for telegraphy and telephony was known, but the first installations of direct current systems were almost solely for lighting. The fact that direct current could not economically be carried over long distances threw some doubt on its value as an all-around source of power.

For industrial purposes, the main power source was the steam engine. Belts and pulleys were used to transmit the power from one steam engine to several machines, but at best the system was cumbersome and inefficient. Sometimes a steam engine was used to compress air and the air was piped to the place where it was needed, as in Westinghouse's own air brake system.

Yet the cry of the times was for more power —power to reach and build new industries, power to produce more goods, power to translate the flowing ideas of an inventive nation into useful merchandise. There was plainly a need for some way to transmit this vital force swiftly and economically from its source to the machines or devices that consumed it, but there was no convincing answer to this need in sight.

Westinghouse had always been interested in power and transmission of power. It was almost inevitable that the possibilities of electricity should capture his imagination. He had toyed with the idea of using electricity in his braking and signaling systems. In 1880 he had invented an automatic telephone exchange. He started a small "electric lighting department" in the Union Switch and Signal Plant at Garrison Alley in Pittsburgh, and in 1884 brought to it the brilliant young electrical engineer, William Stanley, later famous in the annals of electricity. On the basis of Stanley's inventions for an incandescent lamp and for a self-regulating generator and of experiments performed in the electrical laboratory, he started building direct current equipment to be installed in hotels and cities.

But Westinghouse, like many others, was not entirely convinced that electricity was the best source of power. He had yet to appreciate the possibilities of alternating current.

By 1885, Westinghouse had discovered to his own satisfaction that the chief obstacle to the use of direct current electricity as a universal power source was that its pressure, or voltage, could not be controlled without loss. To transmit electrical energy over great distances, the voltage must be high, much too high for the working voltages required at the point of use. Since the voltage of direct current cannot economically be raised or reduced over wide ranges, the voltage produced by the generator must be approximately the same low voltage as that used by the lamps or machinery it supplies. Consequently, direct current generators could provide electricity commercially at distances no greater than a mile. To supply a city would require many generators, and the cost would be prohibitive. To supply outlying communities was out of the question.

The nucleus of young men in the electrical department of the Union Switch and Signal Company had grown, and Westinghouse was still building electrical equipment. But it was not until 1885 that his interest was fully aroused and that he began to bring to the field of electricity the same great vision and leadership with which he had revolutionized the art of railway transportation and the art of handling natural gas.

Guido Pantaleoni, who held a responsible position with the Union Switch and Signal Company, was visiting his native Italy, and there, through his former electrical professor, Galileo Ferraris, he met a Frenchman

by the name of Lucien Gaulard. Gaulard, with John Dixon Gibbs, an English engineer, had invented a system of distributing alternating current, and one of the devices they used was a "secondary generator" which could step the alternating current voltage up or down. Pantaleoni conveyed this information to Westinghouse who was quick to grasp the far-reaching importance of the device. He obtained an option on the system and by autumn of that year, several Gaulard-Gibbs "secondary generators", or transformers, as they later came to be called, were at the electrical department of the Union Switch and Signal Company—along with another brilliant young engineer, Reginald Belfield, who had been closely associated with Gaulard and Gibbs. Belfield and William Stanley undertook to redesign the transformers electrically. Westinghouse and Albert Schmid, a young Swiss engineer, set about redesigning it mechanically. The results were so promising that on January 8, 1886, even before any practical demonstration was performed, Westinghouse organized the Westinghouse Electric Company to manufacture and promote the use of alternating current system equipment.

The practical demonstration came soon afterward. The Gaulard-Gibbs transformer was rapidly changed and revised until a solidly designed, electrically sound commercial transformer emerged. Rights to the Gaulard and Gibbs patents were acquired in February of 1886, and the next month a small New England town witnessed the first demonstration in this country of the alternating current system.

Because of ill health, William Stanley had moved to Great Barrington, Massachusetts. There, with Reginald Belfield, he set up experimental equipment in an abandoned rubber mill about three-quarters of a mile from town and worked steadily to perfect the system. They erected a 25-horsepower steam engine in the old mill and belted it to an alternating current generator which had been sent from England along with the transformers. They connected transformers to the generator and led wires down the main street of the village, fastening them to the elm trees that bordered the sidewalks.

"I have . . . placed a converter (transformer) in my cousin's store in order to test the commercial necessities", Stanley wrote to Westinghouse on March 17, 1886. "The lamps in the store were running well last night . . . I am striving all I can to finish this system for you at the earliest possible date . . . I might say a great deal about the system but briefly, it is all right."

And it was all right! Stanley and Belfield connected a half dozen transformers in the cellars of buildings to be lighted. Then on March 20, 1886, Stanley closed the switch. Lights glowed in the town of Great Barrington, and George Westinghouse, who at thirty-nine years of age had already established a world-wide reputation and had built world-wide businesses, was launched on another career—his most turbulent and triumphant.

The Union Switch and Signal Company moved to Swissvale, a suburb of Pittsburgh, and the Garrison Alley plant became the first home of the Westinghouse Electric Company. Here alternating current equipment was built, including a new constant-voltage alternating current generator which Stanley had designed. The first commercial system was built by autumn of 1886. Under test, it kept four hundred lamps lit for a fortnight in Lawrenceville four miles away—the first successful demonstration of transmission of electricity over any considerable distance. Then the same equipment was shipped to Buffalo, New York, and put into service in November, the day before Thanksgiving. The alternating current system had been proved a success, and the young company started out its new year with orders for twenty-seven additional installations.

But there were immense problems still to be solved. First and foremost was the need for certain critical alternating current equipment. It was one thing to send electricity over great distances, but it was quite another to utilize it as a power source and to measure its consumption. Before alternating current could fulfill its great promise, at least two devices had still to come: an alternating current meter and an alternating current motor. They came within a month

of each other, and they brought another revolution in electricity.

On an April day in 1888, Oliver B. Shallenberger, another of the coterie of young engineers at the Westinghouse Electric Company, was testing an alternating current arc lamp in a laboratory at the Garrison Alley plant. A small spring happened to drop on a spool of a magnet coil near a projecting core of laminated iron. Shallenberger knew that Westinghouse had been casting about for an alternating current meter, and now, as he reached to pick up the spring, he realized that he had accidentally hit upon the principle that would make one possible. For caught in the shifting magnetic field, the spring was slowly rotating. Out of that he knew he could make a meter, and in exactly one month he did.

From this discovery, Shallenberger could easily have satisfied the second great need, for an alternating current motor; but even while he was working on the meter, the principle of the alternating current motor was revealed by two men almost simultaneously. One was Galileo Ferraris, of Turin, Italy, the professor who had introduced Guido Pantaleoni to the inventor of the transformer. The other was Nikola Tesla, whose epoch-making patents for a polyphase system of alternating current were awarded on May 1, 1888.

Westinghouse was prompt to see the importance of Tesla's disclosures, and on July 7 he obtained exclusive rights to them. At the same time, he persuaded the brilliant young inventor to join the Electric Company and help perfect the motor. When Tesla arrived in Pittsburgh, he brought with him a working model of his alternating current motor, but it was not until four years later, in 1892, that it was finally perfected and ready for commercial use.

There were two main reasons for this long and costly development. One was that the motor required a polyphase system. Until that time, alternating current systems were single phase, the current moving forward during one-half cycle, and backward during the second half cycle. Tesla's alternating current, or induction, motor required two or more such currents whose cycles of alternations were not simultaneous. The completely new system of polyphase generation and transmission had to be developed.

The second reason was that the frequency of the alternating current equipment then being built had to be changed. The single phase system used a frequency of 133 cycles a second: current changed its direction back and forth 133 times a second. This was too rapid for the polyphase motor and, after much deliberation, a sixty-cycle system for general use was decided upon and has since remained a standard alternating current frequency.

When these obstacles had been overcome, the induction motor, rebuilt and revised from the ground up, was offered for sale. Industries began installing the polyphase system, and the great shift from steam power to electricity had started.

When electricity first came into use, current was carried in overhead wires—an obvious hazard, but one which attracted little attention until Westinghouse proposed his high-voltage alternating current system of distribution for New York City. Immediately a great hue and cry went up. Every accident was seized upon by newspapers to create in the people's mind a fear of the dangerous and deadly "Westinghouse current". ONE MARTYR MORE, the headlines read; ANOTHER LINEMAN ROASTED TO DEATH, THE ELECTRIC MURDERER, AGAIN A CORPSE IN THE WIRES. Every incident was described in macabre detail, and some newspapers even set up special departments for describing injuries or tragedies resulting from electrical hazards.

When Westinghouse suggested underground cables, one technical writer, dismayed by the whole idea, wrote: "the choice is . . . not between the present electric lighting and the same with underground cables, but between the present system and a return to gas . . . The attempt to place all wires under ground would result in such an original and continued upturning of streets as would render them impassable, and might cause more injury and loss of life from malaria in a month than the electric wires have occasioned in seven years." Thomas Edison, a leading antagonist of the alternating current system, believed that

no insulation was adequate to control Westinghouse's high voltages, and that alternating current in underground cables would burn out its containers and enter houses through manholes!

Through most of this, Westinghouse patiently awaited an opportunity to persuade the public that he was right and his opponents wrong. In the meantime, he wrote one article for the *North American Review* in 1889, "A Reply to Mr. Edison", in which he matter-of-factly refuted statements made in a previous article written by Edison for the same magazine. He moved steadily and courageously against his opposition, sure of the worth of the alternating current system. Whether any other man could have so successfully resisted such violent opposition is open to question; Nikola Tesla, many years after the battle had been won, thought that Westinghouse was the "only man on this globe" who could have done it.

Westinghouse's chance to break through public prejudice against the alternating current system came in the spring of 1892. The directors of the Columbian Exposition, a gala World's Fair to be held in Chicago the following year, had asked for bids from manufacturers for a contract to light the fair grounds. Against formidable competition, Westinghouse received the contract which permitted him to put his alternating current system to a large-scale test.

In less than a year, Westinghouse had built a quarter of a million lamps to light the Fair and to provide ample replacements. Twelve 75-ton polyphase generators, the largest of their kind built in this country up to that time, provided 12,000 horsepower of electrical energy to keep the lamps lit and to run the Westinghouse exhibit. The exhibit itself, apart from the spectacular lighting, displayed a complete polyphase system in operation. A 500-horsepower induction motor, driven from the main generators, turned the polyphase generator for the exhibit. To this generator was attached a transformer which stepped up the voltage. Then came a short transmission line with transformers for lowering the voltage again. The current was used to run induction motors, a synchronous motor, and a new development called a rotary converter, which changed alternating current to direct current for operating a railway motor. A huge marble panel, 1,000 square feet in size, contained all the switchgear to operate both the lighting system and the exhibit, and one man, connected by telephone and messenger with every part of the Fair grounds, could meet any possible emergency simply by throwing a switch.

The lighting and display were proof to the public that the "Westinghouse current" was not the demon they had been led to believe it, but a versatile power, easily and cleanly transmitted and universally useful. The Columbian Exposition spelled the beginning of the end of the "battle of the currents".

The Cataract Construction Company had been formed in the late eighties to finance and execute plans for harnessing the potential power of Niagara's rushing waters.

Late in 1892 Westinghouse completed two 150-horsepower rotary converters. He invited the Cataract Construction Company to inspect them, and early in 1893 Dr. Sellers and two of his colleagues tested them with satisfactory results. The rotary converter was of great importance in the alternating current system, because while alternating current was certainly the best for long-distance transmission, direct current had to be available for certain uses—for example, in railway motors and in *electroplating*. The rotary converter made it possible to transmit current from a large central power station and to change it to direct current in places where direct current was required. This eliminated the last remaining excuse for the transmission of direct current.

The proposal for Niagara Falls called for three 5,000-horsepower polyphase generators, and once again the equipment had to be engineered from the ground up. But in eighteen months, the first water-driven generator was completed. It was installed on April 21, 1895. In November 1895, all three generators were ready for operation, and one year later, three seconds after midnight on November 16, 1896, engineers at Buffalo closed the circuits that brought power from the mighty Niagara, twenty miles away.

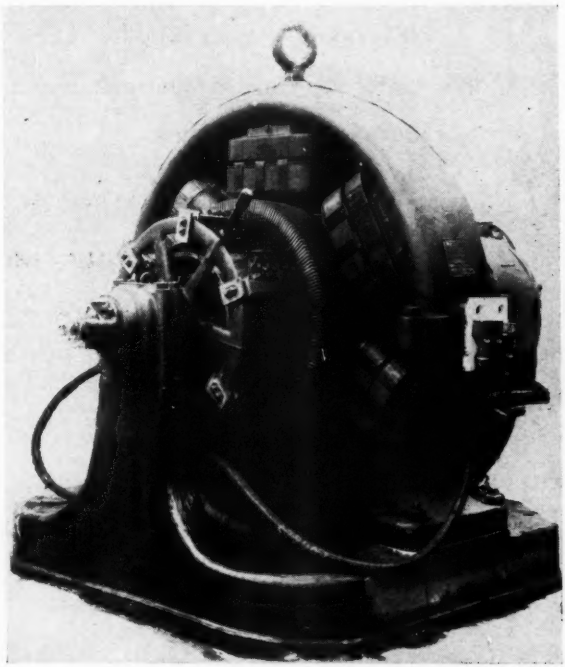
The effect of the Niagara Falls development was far-reaching. Before long, generators at the Falls were providing electric power

or large sections of western New York State. Attracted by the available power, new industries sprang up there. Electrochemical companies gathered until the Niagara Frontier became the largest electrochemical center in the world. Electricity made the commercial production of aluminum possible, and for many years, all the aluminum produced in America came from Niagara Falls. It also facilitated the production of carborundum and a wide variety of other metallurgical products. Inexpensive, versatile power had given rise to a new and growing industrial region.

Westinghouse and his engineers then set about revising the steam turbine to make it suitable for driving electrical generators in the manufacture of electric power. They made important changes both in the turbine and in alternating current generators, and in 1899 the first turbine-driven alternating current generator was installed in Westinghouse's own Air Brake plant at Wilmerding, Pennsylvania. In the following year, 1900, Westinghouse installed for the Hartford Electric Light Company the first turbo-alternator in the country for manufacturing electric power at a central station. The turbine was just about four times as powerful as any other turbine in the world at that time.

Within a few years, the steam turbine made the reciprocating steam engine, along with Westinghouse's own gas engine, obsolete as a driving force for alternating current generators.

The work which he began has been continued on a vast scale. Today 225 billion kilowatt-hours of electric power are consumed each year in the United States alone—almost all transmitted in the form of alternating current.



DC end of an early Westinghouse rotary converter; 300 kw, 650–3,000 volt ac, 3-phase

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(Continued from September Issue)

Uniform, Fine Grained Structure of the Silver Deposit

The photomicrograph in Figure 7 shows the standard silver coating as deposited.

The possible variation in the grain size of the silver plate is surprising. In general, it may be said that the higher the current density, the finer will be the structure of the deposit. (See the "as plated" specimens in Figures 8–16.)

Since the specifications call for heating to as high as 1,000° F, it is important to know what heating will do to the grain size. With the solution and plating conditions mentioned above, it is necessary to plate above 40 amperes per square foot to get a fine grain structure. When the current varies between 30 and 60 amperes per square foot, the deposit will not be uniform. However, above 60 and up to 250 amperes per square foot there will be less variation than

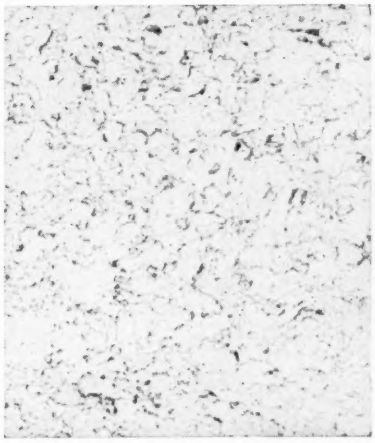


Fig. 7. Structure of silver plate as deposited. X250

TABLE I

Physical Properties of Silver Deposits

$3\frac{3}{4}'' \times \frac{1}{2}''$ specimens with width of narrow section of $\frac{1}{4}''$ were cut with the axis parallel to the axis of the bearing and tested in a tensile machine with a jaw distance of $2''$.

Specimen No.	Treatment	Tensile strength psi	Enlongation $1''$ gauge %	Hardness	
				Rockwell 15W	Vickers
1	As plated	48,000	12	90	—
2	"	48,600	14	92	—
3	"	47,600	13	92	—
4	Annealed	25,600	44	84	—
5	"	25,100	48	83	—
6	"	27,000	42	83	—
7	Annealed	25,000	66	69	45
8	"	25,600	65	69	45
9	"	25,400	59	69	45
10	"	25,300	69	69	45

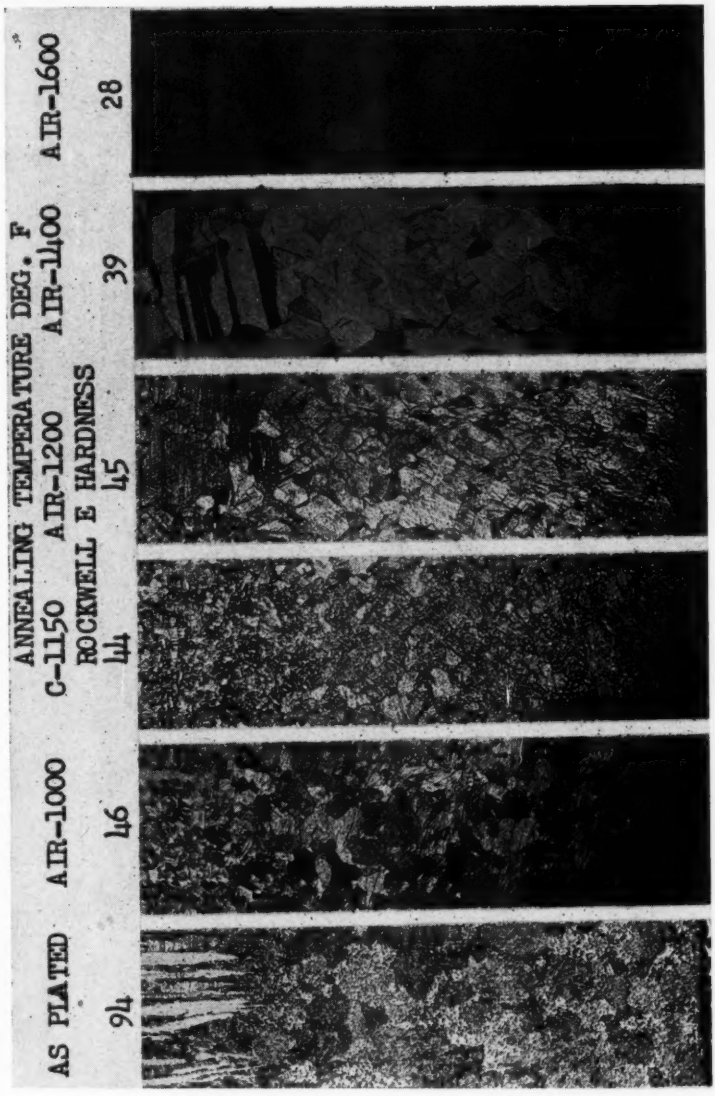


Fig. 8. Structure and Rockwell E hardness after one hour heating at different temperatures of semi-bright silver deposits plated at 90–120° F and 28–43 asf in a bath containing 15.2 oz/gal silver, 14.6 oz/gal potassium cyanide, 14.3 oz/gal potassium carbonate, and brightener

between 30 and 60 (Figs. 8, 10 and 11). For the same plating conditions, the grain size will be larger when carbon disulfide brightener is used than when ammonium thiosulfate brightener is employed, especially in the low current density range. Also, after heating a deposit made with carbon disulfide, the grain size is larger at low temperatures than with ammonium thiosulfate (see Figs. 14 and 15).

Current interruptions cause lamination or banding of the deposit, more so when the bath contains ammonium thiosulfate than when it contains carbon disulfide (Figs. 14 and 15). Heating tends to weaken the adhesion between the laminated sections. This weakness increases with increasing temperature, especially with ammonium

Fig. 9. Structure and Rockwell E hardness after one hour heating at different temperatures of nodular silver deposits plated at 90-120° F and 64-132 asf in a bath containing 15.9 oz/gal silver, 15.8 oz/gal potassium cyanide, 1.1 oz/gal potassium carbonate, and no brightener

thiosulfate brightener in the bath. The longer the period of current interruption, the weaker will be the adhesion between laminations.

Physical Properties of Silver Deposits

The physical properties of the silver deposit will vary somewhat depending on the plating conditions and the annealing temperature. Tests made on specimens plated under our standard conditions gave the results shown in Tables I and II.

Annealing of the electrodeposited silver has at least three effects on its properties: it lowers both tensile strength and hardness, and increases grain size. The magnitude of the effects is influenced by the plating conditions.

Fig. 10. Structure and Rockwell E hardness after one hour heating at different temperatures of bright silver deposits plated at 80–120° F and 71–146 asf in a bath containing 16.4 oz/gal silver, 14.6 oz/gal potassium cyanide, 1.1 oz/gal potassium carbonate, and brightener

TABLE II
Effects of Annealing on Physical Properties of Silver Deposits

Time min.	Annealing temperature °F	Tensile Strength psi	Elongation %
—	—	34,000	19.6
20	775	28,000	40.0
60	900	27,000	50.0
20	1250	26,000	60.0
20	1600	15,000	25.0

The maximum effect of annealing occurs when a low current density deposit is annealed at 800 to 1,000° F with a much more distinct change to a larger grain size than when high current density deposits are annealed.

These and other findings are illustrated in Figs. 8 to 16.

Nodules, Inclusions and Visible Porosity

The amount of brightener in the silver

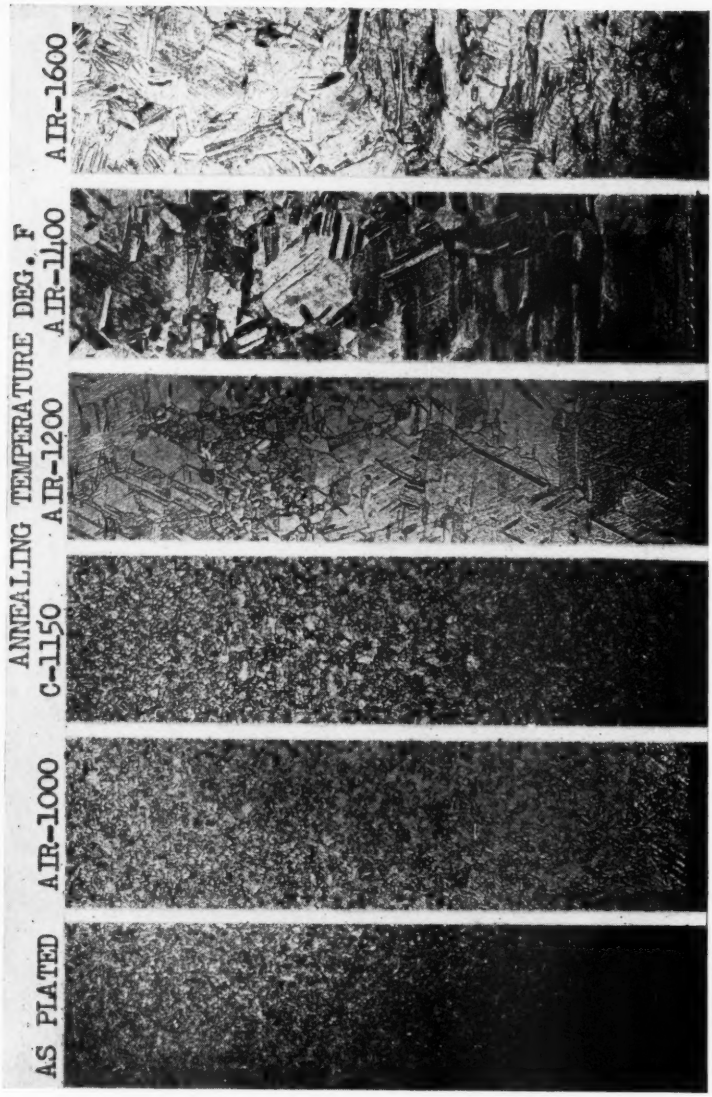


Fig. 11. Structure and Rockwell hardness after one hour heating at different temperatures of nodular but finishable silver deposits plated at 108-120° F and 175-206 a sfin a bath containing 15.0 oz/gal silver, 14.9 oz/gal potassium cyanide, 1.1 oz/gal potassium carbonate, and brightener

solution is of first importance in the production of a deposit free from excess nodules or treeing. Since no satisfactory analytical method is known for determining the need for brightener additions, experience and judgment must be depended on. Our experience led us to use 1/2cc of the brightener per gallon of solution at the start of plating of each vat load of bearings. If the solution had not been used for 24 hours, 1cc per gallon was added.

It was difficult to prove that a nodular plate necessarily produced porosity in the finished silver, but no doubt the nodule free deposit was desirable.

That fine metallic particles from the anode contribute to the roughness of the deposit was shown by the fact that the top flange

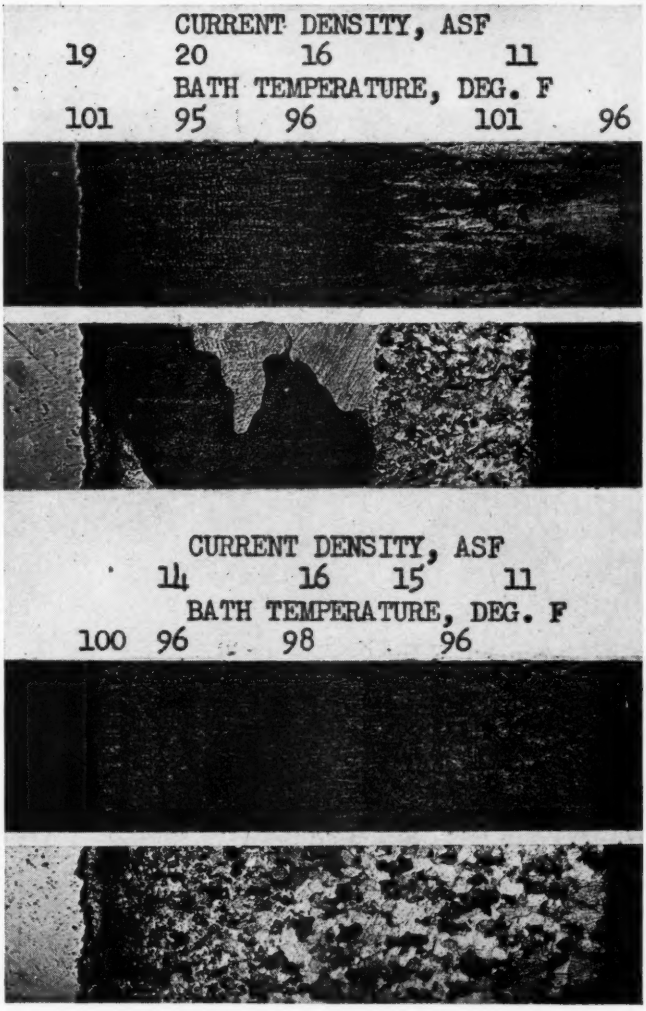


Fig. 12. Effect of carbon disulfide brightener additions made during plating in causing banding and affecting the result of annealing for one hour at 900° F in air. From top to bottom: plated without additions, same after heating, plated with additions, and same after heating

of a bearing was always rougher than the bottom flange. Such roughness could cause porosity. Sometimes a fairly large anode particle would be found included in the deposit, indicated by its different grain size as compared with the deposited metal. Frequently the inclusion of a large particle was accompanied by a void between the particle and the deposited metal. When this condition appeared on the finished surface, it would be called porosity.

Needless to say, cleanliness of the solution is an important factor in the production of a clean deposit. Continuous filtration of the bath has been emphasized as being essential. We, however, started out with the idea that if we build the vats deep enough so that the sediment in the bottom would not be dis-

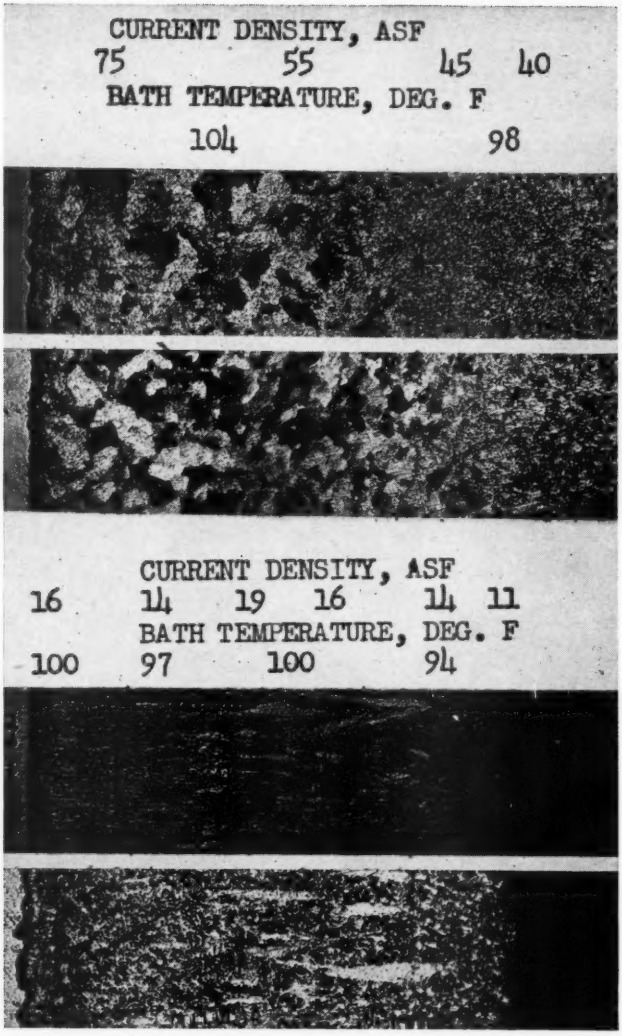


Fig. 13. Another example of effect of carbon disulfide brightener additions. For legend see Figure 12

turbed, we could keep our plating solution clean except for such particles as may come from the anodes during plating. To keep anode particles at a minimum, we bagged the anodes when necessary.

Continuous filtration could not be expected to keep the solution clean between anode and cathode at the time of plating. Air bubbles caused unsatisfactory deposit to be had when we tried continuous filtration on production runs. Because of our plating conditions and limited experience in the use of filters, we were not able to employ continuous filtration of our silver solutions. In spite of this limitation, we did do much satisfactory heavy silver plating.

The microphotograph in Fig. 17 shows a cast silver anode particle as an inclusion

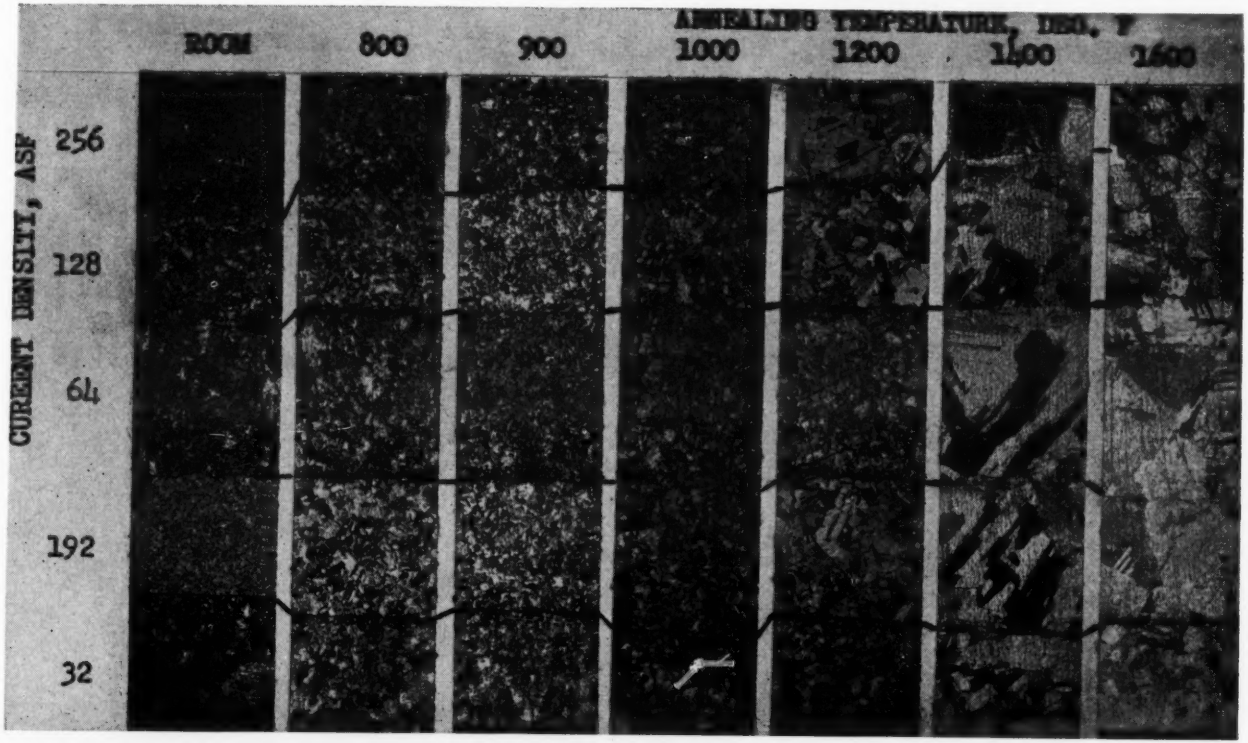


Fig. 14. Effect of plating current density and temperature on structure of coatings deposited from solutions containing ammonium thiosulfate brightener and annealed for one hour

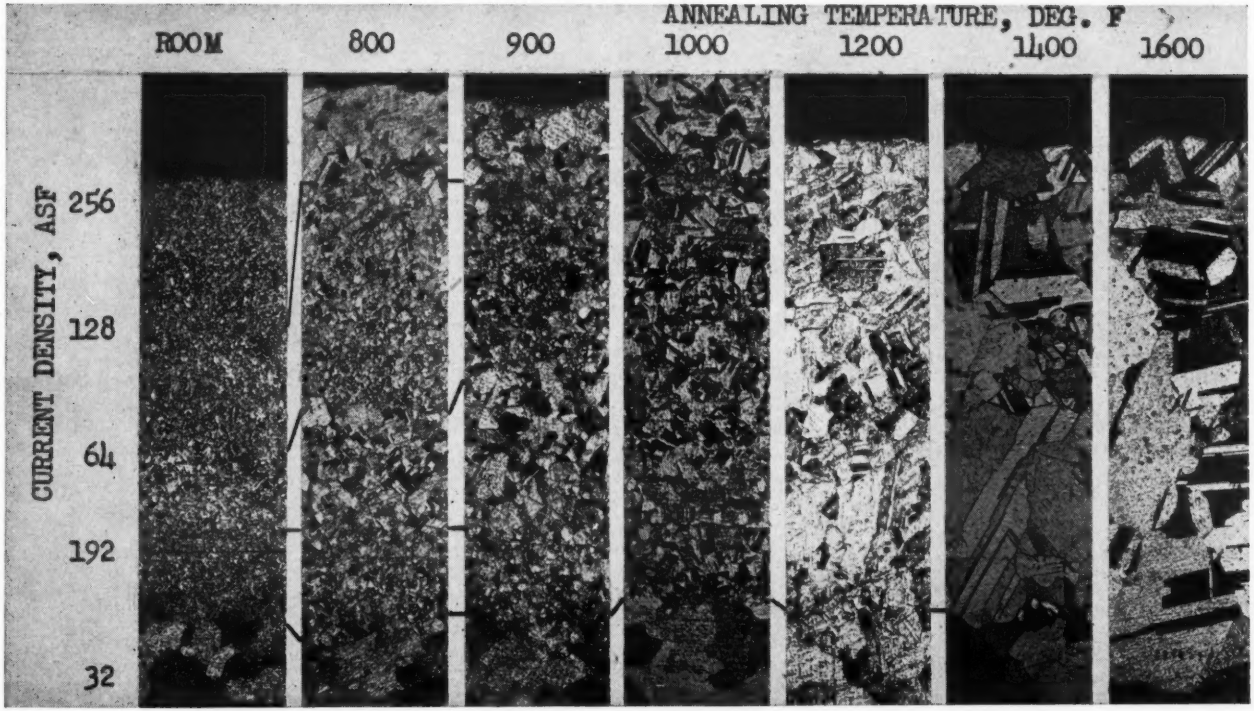


Fig. 15. Effect of plating current density and temperature on structure of coatings deposited from solutions containing carbon disulfide brightener and annealed for one hour

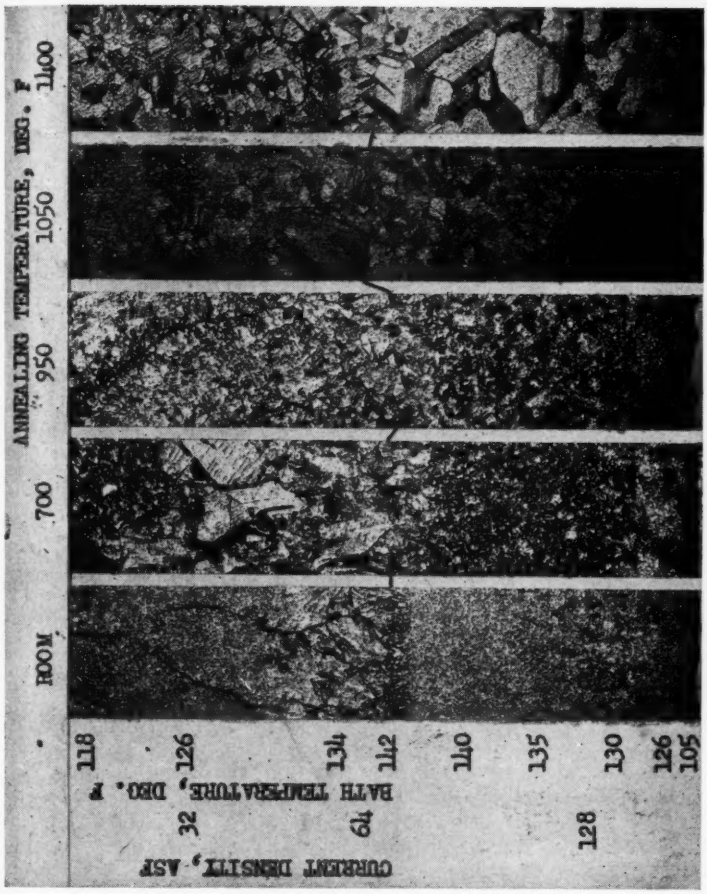
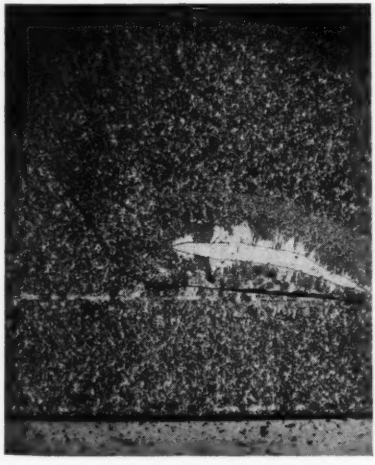


Fig. 16. Effect of current density on the structure of bright silver deposits "as plated" in a bath containing 15.3 oz/gal silver, 11.6 oz/gal potassium cyanide, 0.9 oz/gal potassium carbonate and "as annealed" at different temperatures. Plate is smooth up to 0.020 inch in thickness, rough or nodular in higher thicknesses



in the deposit. Note how its grain size is carried into the deposit, evidently to finish the shape of the grain. This inclusion was the source of the nodule and the void in the deposit. Nodules caused by excess current do not cause voids within the silver.

There is still considerable work to be done to check some of the conclusions reached during our experience in heavy silver plating of bearings, and unquestionably some of the viewpoints expressed here will have to be modified.

Fig. 17. Nodule caused by inclusion of an anode particle. X50 reduced to X25

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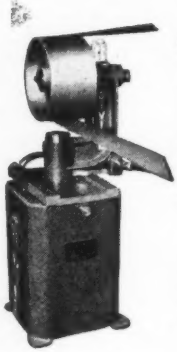
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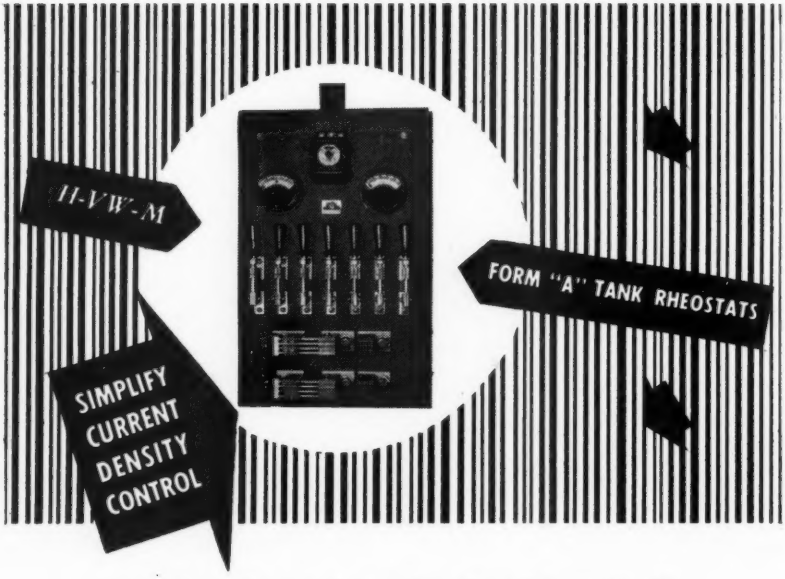

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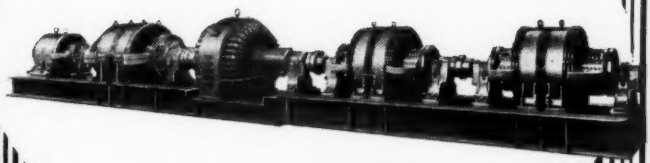

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II. Colorimetric Techniques

Acknowledgement is due the Research Committee, Mr. E. C. Candee, American Brass Company, Chairman; the Research Directing Sub-Committee, Dr. R. M. Wick, Bethlehem Steel Corporation, and Dr. Louis Weisberg, Consulting Chemist, New York City, Chairman and Vice-Chairman respectively; and the Project Sub-Committee, Dr. D. Gardner Foulke, Foster D. Snell, Inc., Chairman, Dr. Walter R. Meyer, The Enthone Company, and Mr. Bernard C. Case, Hanson-Van Winkle-Munning Company for their contribution to this project.

Preface

While analytical methods for the determination of the concentration of major constituents in plating baths have been developed to a point that analysts with a minimum of training can operate them, the same is not true for the determination of small amounts of impurities. As more and more work is done on the effect of very small amounts of foreign ions on efficient and successful plating operations, it becomes evident that simple, rapid, and fairly accurate methods of analysis should be available for these ions.

The chemical and electroplating literature contains comparatively few methods for the analysis of trace elements in plating baths. The only series of paper found are those reported by Foulke [1, 2, 3, 4].

There are many types of analytical methods. A partial list includes gravimetric, volumetric, colorimetric, polarographic, spectrographic, and electrolytic methods. What types of analytical methods are most suitable for the analysis of trace constituents in plating baths? Table I indicates the important characteristics an analytical method should have and roughly how well each of the common types of analytical procedures fulfills the implied requirements.

A study of Table I indicates colorimetric methods to be most suitable for this work. Therefore, whenever possible, colorimetric methods will be developed or adapted for the analysis of trace constituents in plating baths.

Since the principles of spectrophotometry and colorimetry have been discussed in a previous article[5], they will not be repeated here. The rest of this paper will be devoted to a description of the operational technique involved in spectrophotometric work.

Spectrophotometric Instruments

Although spectrophotometric methods involve both visual and photoelectric means of measuring the intensity of the light trans-

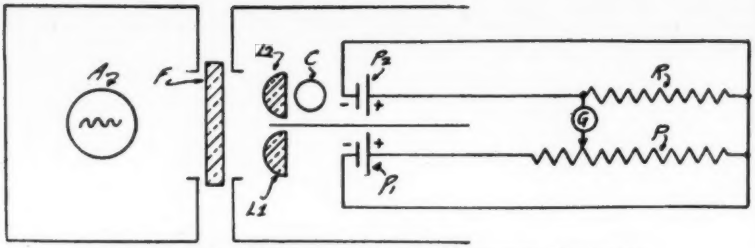

Fig. 1. Essential features of Klett-Sommerson colorimeter

mitted by the solution, only the latter will be discussed briefly. In this type of measurement, the transmitted light is directed to a photoelectric cell and the current generated is a measure of the amount of light transmitted by the colored system. Photoelectric type instruments can be roughly classified into two groups:

(1) Those in which colored glass filters are used to produce monochromatic light . . . called filter photometers or abridged spectrophotometers.

(2) Those in which a prism or grating is used to supply monochromatic light . . . called spectrophotometers.

The light obtained by either method is not strictly monochromatic. The wave length band is about 5 to 35 millimicrons in width for instruments in group (2) and about 100 millimicrons for the best filters in group (1). (Note 1 $m\mu$ = 1 x 10^{-7} mm.)

A typical example of an abridged spectrophotometer is the Klett-Sommerson colorimeter, the essential features of which are shown in Fig. 1.

(A) is a 100-watt projector lamp. (F) is a glass filter through which light emerges approximately monochromatic. The light from compensating lens (L_2) passes through a test tube cell (C) . . . a cell with plane parallel sides is also provided . . . and then impinges on the photoelectric cell (P_2). The light from lens (L_1) falls directly on cell (P_1). The current from (P_2) which is a measure of the light transmitted by the solution deflects the galvanometer needle and the resistance (P) is varied to bring the galvanometer back to its original, or zero, position. The resistor (P) has an attached scale which is calibrated in units proportional to the extinction of the solution under examination.

A reading is made in the following manner: The projector lamp is turned on and about 10 minutes allowed for it to reach constant light intensity. The filter is inserted, and the galvanometer needle adjusted to its zero position. The test tube cell containing the reference solution is put in position, the resistor scale set to zero, and the galvano-

TABLE I

Characteristics of Analytical Methods

Type of Method	Characteristics					
	Rapidity	Accuracy	Simplicity of operation	Cheapness of operation	Simplicity of calculations	Sensitivity
Gravimetric	Low	High	High	High	Medium	Medium
Volumetric	Medium	High	High	High	Medium	Low
Colorimetric	High	Medium	High	High	High	High
Polarographic	High	Medium	Low	Low	Low	High
Spectrographic	High	Medium	Low	Low	Low	High
Electrolytic	Medium	High	High	High	High	Medium

meter needle again adjusted to its zero position. The tube containing the reference solution is withdrawn, the solution is thrown away, and the tube is partially filled with the test solution and replaced in the cell holder. The galvanometer needle will be deflected and is now brought back to its zero or null position by adjustment of the resistor (P). The reading of the scale attached to the resistor is a measure of the amount of light the test solution transmits. The scale readings are related to the extinction by the formula.

$$\text{Log} \frac{I_0}{I} = 0.002R$$

where R is the scale reading for the instrument described above.

the slit (D), and light of the wave length for which the prism is set passes out of the monochromater through the exit (upper) slit and through the absorption cell (G) to the photoelectric cell (H).

A reading is made in the following manner: Lamp (A) is turned on, the slit (D) is adjusted to the desired width, the prism is set for the desired wave length (wave length scale on the instrument), the reference solution is placed in the first of a set of four 1-centimeter absorption cells, and resistors (not shown) are adjusted so that with the scale set at 100 per cent transmittancy or zero extinction, the null galvanometer pointer is at its zero position. The carriage which holds the set of four cells is now pulled forward so that the light passes through the

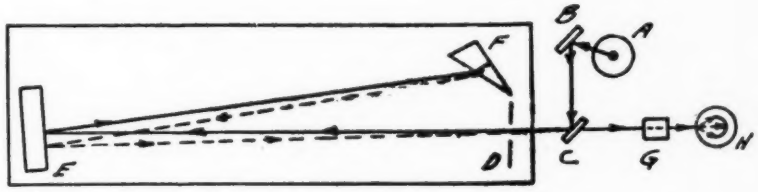

Fig. 2. Essential features of Beckman spectrophotometer

The Beckman spectrophotometer is a typical example of the second type of instrument although more expensive than many similar instruments. Spectrophotometers are usually too expensive for a small plating establishment unless it is interested in developing its own analytical methods. Fig. 2 illustrates the essential features of the instrument.

An image of the light source (A) is focused by the condensing mirror (B) and the diagonal mirror (C) on the entrance slit at (D). The entrance slit is the lower of two slits placed vertically over each other. Light falling on the collimating mirror (E) is rendered parallel and reflected toward the quartz prism (F). The back surface of the prism is aluminized so that light refracted at the first surface is reflected back through the prism undergoing further refraction as it emerges from the prism. The collimating mirror focuses the spectrum in the plane of

cell containing the test solution. The scale resistor is rotated until the galvanometer pointer returns to zero. The reading on the scale attached to the resistor is a measure of the amount of light transmitted by the test sample. The instrument is calibrated to give readings in per cent transmittancy or extinction. For a more thorough description of photoelectric instruments and their use, the reader is referred to references [6, 7, 8, 9].

Experimental Procedures

If the procedure for the determination has been worked out and the colored system is known to possess characteristics suitable for colorimetric work, the first step is to determine how the color intensity or fraction of the incident light transmitted by the colored system varies with the wave length of the light used. This is done by developing the colored system in a solution free of impurities

and measuring the light transmitted by the solution at various wave lengths. The per cent transmittancy of the solution is then

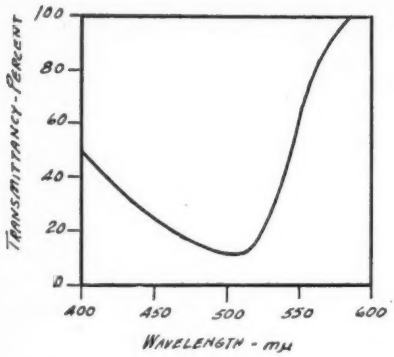

Fig. 3. Typical transmittancy curve—for the iron-o-phenanthroline system

plotted against the wave length on rectangular co-ordinate graph paper. The resulting curve is called a transmittancy curve. Fig. 3 shows a typical transmittancy curve for the iron-o-phenanthroline system. Only a spectrophotometer can be used in the preparation of transmittancy curves.

From Fig. 3, one can see that little light is transmitted by the solution at some wave lengths while at others most of the light is transmitted. This is true of all colored solutions. No two solutions of different character will have transmittancy curves of exactly the same shape. An examination of the iron-o-phenanthroline transmittancy curve shows a minimum transmittancy point at around 510 millimicrons. At this wave length, more light is absorbed than at any other, and the change in transmittancy with concentration is a maximum. Therefore, the colored system is most sensitive when light of about 510 millimicrons is passed through the solution and light of this wave length should be used in all subsequent operations to attain maximum sensitivity unless some substance is present which also absorbs strongly at this wave length. For example, in Fig. 4 are shown the transmittancy curves for nickelic dimethylglyoxime and ferric citrate in ammoniacal solution. The nickel curve shows maximum sensitivity at about 440 millimicrons, and the iron color also absorbs an appreciable amount of light of this wave length. Therefore, since the iron color cannot easily be eliminated, it is best to use a wave length of 525–550 millimicrons in the determination of nickel by this method because the iron color will not interfere in this range. It is practical to use this technique to eliminate the effect of an interfering ion whenever possible if the method is not rendered too insensitive.

If an abridged spectrophotometer is to be used, a filter must be selected with a region of maximum transmittance that most nearly corresponds to the wave length band which transmittancy curves show best to use for the colored system. Most instruments can be obtained with a set of filters that cover the visible spectrum. Table II indicates the colored filters to use with different colored solutions[6].

TABLE II

Suitable Filter Colors for Various Solution Colors

Filter Color	Solution Color
Green	Purple
Blue to blue-green	Orange to red
Blue	Yellow
Purple	Violet or red
Red	Blue

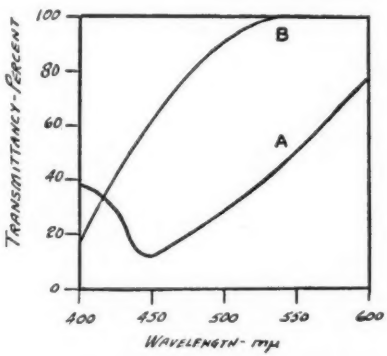

Fig 4. Transmittancy curves for nickelic dimethylglyoxime (A) and ferric citrate (B) in ammoniacal solution

Calibration Curves and Blank Determination

Having found the proper wave length band or filter for maximum sensitivity and minimum interference from other colored ions that may be present, one is ready to collect data from which to plot calibration curves. The instrument is turned on, the wave length dial turned to the desired value or the proper filter inserted, the absorption cell filled with the reference solution—usually the pure solvent in the colored solution—and the instrument adjusted for 100 per cent transmittancy in the manner described under the discussion of instruments.

A series of runs are now made in which varying amounts of a standard solution of the constituent sought are added to similar aliquots of a solution as nearly identical as is possible or necessary to the solution in which the constituent will have to be determined. The color in each run is now developed in exactly the same manner. A portion of each solution is transferred, in turn, to the absorption cell and the per cent transmittancy or extinction of the solutions is measured. After taking a reading, the cell is rinsed out a few times with small portions of the next solution before it is filled again and the measurement taken. This technique minimizes errors that may occur due to differences in the amounts of the constituent present in the solutions. From time to time, the cell is refilled with the reference solution and the 100 per cent transmittancy of the instrument checked. If the setting has changed, it must be readjusted before more readings are made. If one has two cells that are exactly matched, the reference solution can be put in one, and the setting can be checked by placing this cell into the cell holder.

The scale readings obtained are usually NOT an accurate measure of the amount of incident light absorbed by the colored system. Some light may possibly be absorbed by the solvent, by the excess of color forming reagent, by other reagents added in the course of developing the color, or by very small amounts of the desired constituent in the added reagents even though they may be the purest available. Errors due to these factors can be greatly minimized by running a determination in which everything is added except the constituent sought. The absorption due to this solution is measured as above. This is called a "blank" and in routine work should be run from time to time as it is usually not constant.

When transmittancy or extinction readings obtained with known amounts of the desired constituent have been corrected for the reading of the blank, they are a more accurate measure of the incident light transmitted by the colored system.

The method of correcting for the blank depends on whether per cent transmittancy or extinction is measured. If extinction or a unit proportional to the extinction is measured, one has only to subtract the extinction of the blank from the reading of the sample to get the exact extinction of the sample. If per cent transmittancy is measured, the calculation involved is somewhat complex. A sufficiently good approximate correction can be made by dividing the observed transmittancy by the transmittancy of the blank. The following are examples of these blank correction methods:

(1) Observed reading for a colored system on a Klett-Sommerson Colorimeter 125
Observed reading for the blank ... 21
Corrected reading for the colored system . . . . . 125—21 = 104

(2) Observed per cent transmittancy of a solution 62.0
Observed per cent transmittancy of the blank 96.0
Corrected per cent transmittancy of the solution ..... $\frac{62.0}{96.0} = 64.6$

Calibration curves are drawn by plotting blank corrected transmittancy readings against concentration on semi-logarithmic paper or by plotting corrected extinction readings against concentration on ordinary graph paper. In both cases, straight line curves will be obtained if Bouguer-Beer's law is obeyed over the concentration range tested. The calibration curve should be checked from time to time. This can be done well enough by verifying the position of one

of the points situated some distance from the origin.

Calculations of Results

The calibration curve having been prepared, one can now determine the desired constituent when present in an unknown quantity in a plating bath. The amount of light transmitted by the unknown in which the color has been developed is corrected for the blank, and the concentration of the constituent sought corresponds to the corrected scale reading off the curve.

Suppose that in the determination of iron by the o-phenanthroline reaction, the corrected scale reading with a Klett-Sommerson colorimeter is 150. Look up 150 on the scale reading axis and from the concentration axis read off the amount of iron that corresponds to a scale reading of 150. Suppose it is 25 gammas of iron. A gamma (γ) is equal to 0.001 milligrams. If one milliliter of a plating bath is taken for analysis, the amount of iron in grams per liter is $\frac{25}{1000} = 0.025$.

Whenever a run is made on a bath in operation, a blank should be run along with the sample. However, the blank cannot be prepared in the same manner as described under preparation of the calibration curve because the bath contains the constituent being determined. Two alternatives can be used. (1) An aliquot of the bath can be left out and the procedure carried through as usual. This will give any blank due to the reagents used, but will not compensate for the possible interference of other materials in the bath. (2) An aliquot of the bath can be taken and all reagents added except the color forming reagent. This gives a blank that will correct for everything except color formation between the reagent and some other material in the bath. Of the two methods, the latter seems to be better. When the constituent sought is separated from all other interfering substances during the course of the procedure, method (2) for preparing the blank will be fairly accurate. If not, it should be used with the realization that the determination will be less accurate. There are some cases in which method (1) will have to be used. For example, in the determination of lead in nickel plating baths by the dithizone method, the lead is extracted from the solution leaving the nickel behind. Since the dithizone is the color forming reagent as well as the separating medium, method (2) is impossible and one has to omit an aliquot of the plating bath in preparing the blank with a resulting loss in accuracy of the determination.

If the instrument on hand has an extinction scale or a scale with markings which are proportional to the extinction, it is not essential to prepare a calibration curve. This is an advantage of this type of scale over a per cent transmittancy scale. Develop the color in an aliquot of the bath under test, in a similar solution containing a known quantity of the desired constituent and in a blank. Correct the sample and the standard for the blank. The concentration of the constituent in the bath is then given by the equation

$$\frac{\text{concentration of constituent in standard}}{\text{corrected reading of standard}} \times \text{corrected reading of sample} = \text{concentration of constituent in sample.}$$

Once the factor

$$\frac{\text{concentration of constituent in standard}}{\text{corrected reading of standard}}$$

has been determined, it is not necessary to run the standard again. If the blanks are reasonably constant, the product of this factor times the corrected scale reading of the sample will give the concentration of the constituent sought.

Conclusion

Many of the techniques of colorimetric work described in this article will be used over and over again in subsequent papers. Rather than repeat the description of the technique of preparation of calibration curves, adjustment of the spectrophotometer for 100 per cent transmittancy, etc., references will be made in future papers to their description in this introductory paper.

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III. Lead In Nickel Plating Baths

In collaboration with
G. FREDERICK SMITH and FREDERICK DUKE

Summary

A method for the determination of lead in nickel plating baths is described. The lead is separated from interfering ions by extraction with a carbon tetrachloride solution of dithizone in the presence of potassium cyanide. After removal of the excess dithizone with alkaline potassium cyanide, the transmittancy of the solution is measured and the quantity of lead present determined from a calibration curve.

Introduction

The purpose of this investigation was to develop a rapid, accurate method for the determination of very small amounts of lead in nickel plating baths which also contain appreciable quantities of aluminum, cadmium, copper, iron, manganese, silicon, zinc, calcium, and chromium.

It was also desirable to restrict the method selected to one which does not require the use of costly equipment or the employment of a well trained and experienced chemist.

These limitations led to the search for a spectrophotometric method. The apparatus required is inexpensive, does not require the services of an experienced chemist, and the results are both rapid and fairly accurate.

From a survey of the literature, the method which seemed most likely to give satisfactory results is the dithizone method first used by Fischer and Leopoldi[7].

The electrolytic separation of lead as lead dioxide, PbO_2 [14,2,20] and its oxidation of tetramethyldiaminodiphenylmethane to the intensely blue colored diphenylmethane dye was studied[22]. The method is simple and rapid, but it is not as accurate as the dithizone method especially for small amounts of lead—10 gamma or less. Any other peroxide like manganese dioxide, MnO_2, that might possibly be deposited along with the lead dioxide will oxidize the reagent. Furthermore, the color is not very stable.

Lead can be determined indirectly by precipitating it as lead chromate, dissolving the thoroughly washed precipitate in acid, and determining the amount of chromate present with s-diphenyl carbazide which forms an intense red-violet colored solution[13], [12]. However, the method was known to give low results[13], [3] and was not considered further.

Since its introduction, the dithizone method has been used extensively for the determination of lead in biological materials[3], [11], water[21], silicate rocks[16], and in many other substances.

Many elements besides lead react with dithizone to form colored complex compounds[17] namely manganese, iron, nickel, cobalt, copper, zinc, palladium, silver, cadmium, (indium), tin, platinum, gold,

mercury, thallium, and bismuth. However, when potassium cyanide is added to a slightly alkaline solution in quantities sufficient to form complex cyanides with all the metallic ions present, lead, bismuth, thallium and stannous tin are the only elements that can react with dithizone. Since bismuth, thallium and stannous tin are not usually present in nickel plating solutions, lead may be isolated by this means from all the other elements in the bath. If it is necessary to separate lead from these metals, methods are available for doing so[23, 10, 9, 15].

The lead separation is satisfactory only when the pH has been properly adjusted and enough potassium cyanide has been added to complex all the metallic ions present. With less, some of the other metals in the solution will be extracted with the lead—usually nickel. The importance of this point is illustrated by the amounts of potassium cyanide required when runs are made on a Watts type nickel plating bath without and with impurities added. The former requires 8.5 milliliters of 5 per cent potassium cyanide solution. The same amount added to the same quantity of bath containing impurities is not enough. Even after ten extractions with dithizone had been made, lead was still present in the aqueous phase. Since only three or four extractions are required to remove the same amount of lead from the pure bath and since the pH of both solutions were the same, it is evident that some other metal was being extracted along with the lead. When 12 milliliters of the potassium cyanide solution was added, 3 or 4 extractions removed all the lead. However, one must be careful not to add too great an excess of potassium cyanide as it too will increase the number of extractions required.

As noted above, the pH of the solution from which lead is to be extracted must be carefully controlled. Clifford and Wichmann[4] studied the extractability of lead at various acidities. Using a chloroform solution of dithizone, they found the optimum pH range to be about 8.0 to 10.0. With a carbon tetrachloride solution of dithizone, the optimum range was about 8.0 to 10.0. Below 8.0, many extractions were necessary, and above the upper limit, the lead dithizonate decomposed. In this investigation, it was found necessary to confine the pH range between 8.5 and 9.0 in order to keep the number of extractions to a minimum.

After the lead has been isolated, there are a number of ways in which the quantity of lead may be determined[19].

(1) The Mono-color Method[19, 6, 8]. The excess dithizone in the lead extractions is removed by shaking the extracts with a dilute ammonia-potassium cyanide mixture. After dilution of the lead dithizonate with pure solvent to a definite volume, its transmittancy is measured either by means of a spectrophotometer at 520 millimicrons wave length or a filter photometer with a filter which provides maximum transmission around this wave length. The lead concentration is then obtained from a calibration curve. As an alternative, the pure lead dithizonate can be decomposed by making the solution slightly acid, and the transmittancy of the green organic solvent layer determined after dilution to a suitable volume at 610 millimicrons or by means of a filter with maximum transmission around this wave length.

(2) The Mixed Color Method[1, 11, 4, 5, 19]. In this method, the lead dithizonate is decomposed by adding dilute acid, throwing away the organic solvent layer, adjusting the pH to about 9.5 with ammonium citrate or tartrate, adding potassium cyanide, and shaking the solution with a definite excess of dithizone solution of known concentration. The organic layer will have a blue or red-violet color depending on the amount of excess dithizone and the amount of lead. The determination is made by measuring the amount of light transmitted by the solution at 520 millimicrons which is the wave length at which lead dithizonate shows maximum absorption or at 610 millimicrons, the wave length at which dithizone absorbs light strongly. The latter method is the more accurate because the lead dithizonate shows little light absorption above 600 millimicrons while dithizone absorbs appreciably at 520 millimicrons. It does, however, require closer pH control.

(3) The Standard Series Method[19]. This is a visual method of estimating the

amount of lead present. As in the mixed color method, the lead is isolated, transferred to the aqueous layer and shaken with a measured excess of dithizone solution. At this point the organic layer is transferred to a glass stoppered tube and its hue is compared to those of a series of solutions containing known amounts of lead and the same amount of dithizone placed in similarly prepared tubes.

(4) Colorimetric Titration[19]. This method does not make use of a series of standards. Instead, to one tube containing the same amount of all reagents except lead as the unknown, a standard solution of lead is added from a micro burette until the mixed color of the standard matches that of the unknown.

For this investigation, has been selected the mono-color method in which the light absorbed by the lead dithizonate at 520 millimicrons is measured since it is the most rapid and is capable of giving results accurate to 1 gamma when properly carried out[4]. In 1944, a similar method for lead in plating baths was described by Foulke[9a].

Experimental

From a study of the previous work on the determination of lead with dithizone and the results obtained from our own preliminary experimental work, a routine procedure was developed based upon the separation of lead from interfering ions by extraction with a carbon tetrachloride solution of dithizone in the presence of potassium cyanide. After removal of the excess dithizone with alkaline potassium cyanide, the transmittancy of the solution is measured and the quantity of lead present determined from a calibration curve. The detailed recommended routine procedure appears at the end of this paper.

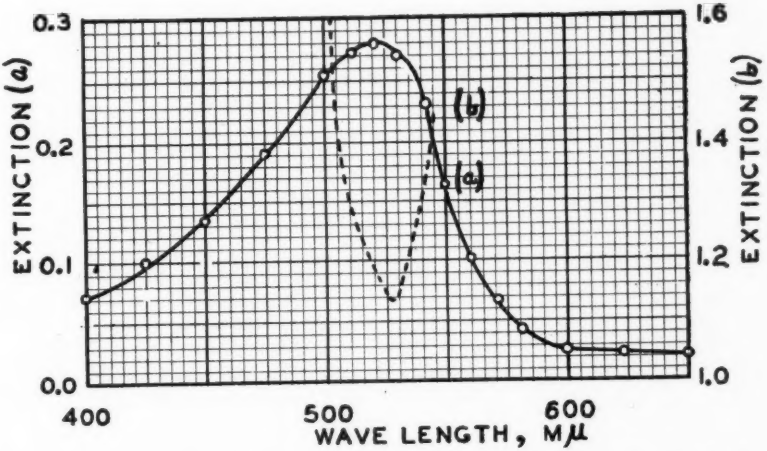

Fig. 1. Extinction vs. wave length for lead dithizonate containing 20 ppm lead in carbon tetrachloride. (a) With spectrophotometer, (b) with Klett-Sommerson filter No. 54. The extinction units to the right apply to curve (b)

The experimental work done was divided into three parts:

(1) Preparation of a transmittancy versus wave length curve for lead dithizonate dissolved in carbon tetrachloride.

(2) Preparation of a calibration curve relating transmittancy to concentration of lead using the recommended routine procedure.

(3) Determination of the accuracy and the precision of the proposed method.

TABLE I

Calibration Curve Data

Lead Added gamma	Corrected Readings	Average Readings	Mean Average Reading
5	36–37–35	36	
5	29–38–36	38	36
5	35–31–34	33	
10	64–61–58	61	
10	67–64–64	65	67
10	77–74–75	75	
20	142–132–136	137	
20	145–140–136	140	137
20	136–134–135	135	
30	197–195–196	196	
30	220–219–212	217	204
30	204–200–195	200	
40	252–254–245	250	
40	265–252–280	268	258
40	265–240–258	255	
50	360–345–325	344	
50	335–330–325	330	334
50	325–330–330	328	

Preparation of the Transmittancy Versus Wave Length Curve

A solution of lead dithizonate in carbon tetrachloride containing 20 micrograms of lead per milliliter was prepared and a portion placed in the cell of a Beckman spectrophotometer. The curve obtained by plotting the transmittancy against the wave length is shown in Fig. 1. It will be noted that the solution absorbs strongest at about 520 millimicrons.

Fig. 1 also shows the transmittancy versus wave length curve (curve b) for the Klett-Sommerson green filter No. 54 recommended in the procedure. It will be noted that the wave length range over which its transmittancy is maximum corresponds to the wave length at which the lead dithizonate absorbs the strongest. When the maximum transmittancy of the filter approximately coincides with the wave length band at which a solution shows maximum absorption, the use of a filter will result in the greatest sensitivity of the method.

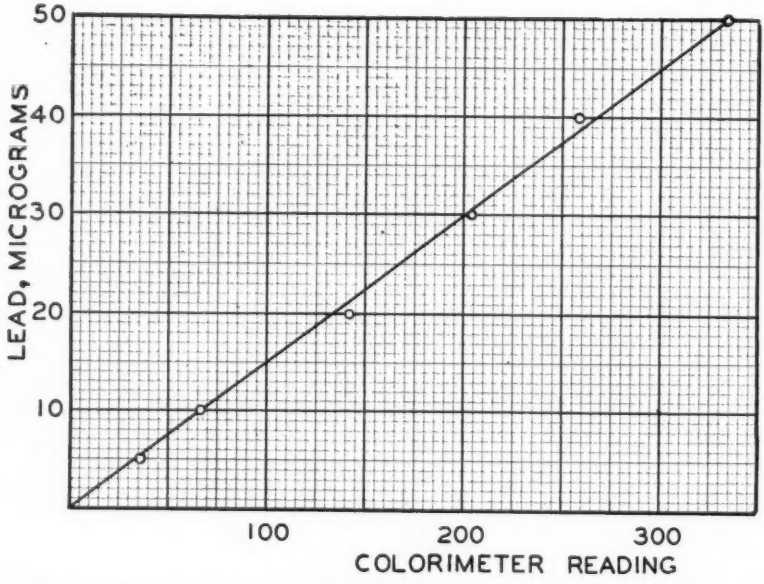

Fig. 2. Calibration curve for the determination of lead in a Watts type nickel plating bath by the dithizone method. Instrument used: Klett-Sommerson colorimeter with green filter No. 54. Type of cell: test tube. Final volume of solution: 25 ml. Slope of curve: 0.148 gamma lead per scale reading

Preparation of the Calibration Curve

The data shown in Table I was obtained when the recommended routine procedure was followed in adding varying quantities of the standard lead solution to one milliliter of a synthetic Watts type plating bath.

The calibration curve shown in Fig. 2 was obtained by plotting the mean average readings against the corresponding lead content of the solutions.

The straight line obtained shows that Bouguer-Beer's law is obeyed by lead dithizonate dissolved in carbon tetrachloride over the concentration range tested. The molar extinction coefficient of the solution was found to be fairly constant with varying amounts of lead as it should be if Bouguer-Beer's law is obeyed. The average value of the molar extinction coefficient was 8.29×10^4 at a wave length of 520 millimicrons.

Determination of the Accuracy and the Precision of the Method

To check the accuracy and precision of the method under conditions that will usually be met with in industrial practice, other metallic ions were added to 100 milliliters of the synthetic Watts bath which had been used in the preparation of the calibration curve. This solution was then used in the tests.

TABLE II

Kind and Amount of Impurities Added

Metal Ion	Amount Added mg	Equivalent in g/l
Aluminum	100	1.0
Cadmium	100	1.0
Chromic trioxide (CrO_3)	20	0.2
Copper	20	0.2
Manganese	100	1.0
Iron	100	1.0
Silicon	100	1.0
Zinc	100	1.0
Calcium	Saturated	Saturated

Table II shows the ions and the amounts which were added to the pure bath. Solid, soluble nitrates, chlorides, or sulphates of the various metals were used wherever possible.

All salts dissolved readily except the 200 milligrams of calcium chloride added. The solution was heated, shaken vigorously, cooled, shaken well again and then filtered. The filtrate was used for the tests.

TABLE III

Accuracy of Method

Lead Added gamma	Corrected Readings	Average Reading	Lead Recovered gamma
5	33–34–36	34	5.0
10	60–67–68	65	9.5
20	162–160–140–150	153	20.5
40	275–295–290–270	282	41.3
50	325–325–330	327	48.0

The same procedure was followed as that used in the preparation of the calibration curve. Table III shows the results procured in checking the accuracy obtained on single runs. When the procedure is closely followed, the method will give an accuracy of better than 10 per cent.

In order to further check the accuracy of the method, enough lead was added to the synthetic plating bath used above so that each milliliter contained 20 micrograms of lead. A portion of this solution was analyzed for lead by the writers and samples were sent to the Bethlehem Steel Co., Bethlehem, Pa.; Foster D. Snell, Inc., Brooklyn, N. Y., and Bell Telephone Laboratories, New York, N. Y. These companies had kindly consented to test the procedure described in this paper.

TABLE IV

Results from Cooperating Laboratories

Laboratory	Lead Found microgram /ml
Foster D. Snell, Inc.	21
Bethlehem Steel Company	22.3
Bell Telephone Laboratories	20.5
Lehigh University	21.0

The results obtained by the various laboratories are presented in Table IV.

To test the precision of the method, six duplicates containing 20 gamma of lead

were run. The results are shown in Table V. The precision is fairly good, but only if the details are followed exactly.

TABLE V

Precision of Method

Lead Added gamma	Corrected Readings	Average Reading	Lead Recovered gamma
20	156–136–141–138	143	20.5
20	149–147–139	145	20.5
20	141–139–137	139	20.0
20	157–153–151	154	22.0
20	143–151–138	142	20.2
20	152–150–130–140	143	20.5

Recommended Routine Procedure

REAGENTS REQUIRED:

(1) *Dithizone solution—0.1 gram/liter*

The commercial dithizone usually purchased has a purity of 80–90 per cent. The main impurity is an oxidized form of dithizone called diphenylthiocarbodiazone which interferes in most dithizone methods. In carbon tetrachloride, it forms a yellow to brown solution which may alter the transmission of the solution under examination. Hence, it is desirable to remove as much of it as possible. In the purification of the dithizone solution, advantage is taken of the fact that the diphenylthiocarbodiazone is not soluble in a basic solution while dithizone is soluble.

To purify[6, 18], dissolve 100 mg reagent in 50 ml carbon tetrachloride and filter off any insoluble matter catching the filtrate in a 150 ml Squibb type separatory funnel. Add 50 ml of a 1:100 solution of NH_4OH and shake for about one minute. After the liquids have separated, run the carbon tetrachloride layer into another separatory funnel containing 50 ml of the 1:100 NH_4OH and shake again. This second extraction will remove practically all the dithizone from the carbon tetrachloride layer. It should be colorless or have a light green color at this point. Discard the carbon tetrachloride layer and combine the two aqueous NH_4OH extracts. Wash these extracts four times with 10 ml portions of carbon tetrachloride. This will take out any diphenylthiocarbodiazone present. Now precipitate the dithizone with 2 ml of concentrated HCl and shake for a minute. Finally, extract the precipitated dithizone with 25 ml portions of carbon tetrachloride until the aqueous layer is colorless. Run these extracts into a pyrex liter flask and dilute to one liter with carbon tetrachloride. To protect the solution against oxidation, overlay it with a 5 per cent solution of pure hydroxylamine hydrochloride, one centimeter thick. Keep the solution in a cool, dark place. It is stable for several months if kept in a refrigerator.

(2) *Potassium Cyanide Solution—5 per cent*

Dissolve 50 g of the fresh salt in sufficient water to make 1 l solution. Keep the solution in a pyrex flask or bottle.

(3) *Alkaline Potassium Cyanide Solution*

Mix 10 ml of the above 5 per cent KCN solution and 5 ml of concentrated NH_4OH and dilute to one liter.

(4) *Sodium Tartrate Solution—10 per cent*

Dissolve 100 g of the salt in distilled water and dilute to 1 l.

(5) *Concentrated Ammonium Hydroxide—c. p. grade*

(6) *Tartaric Acid—50 per cent*

Dissolve 25 g tartaric acid in distilled water and dilute to 50 ml.

(7) *Thymol Blue Indicator*

The indicator is used if a pH meter is not available.

(8) *Synthetic Watts Type Nickel Plating Bath*

330 g $NiSO_4 \cdot 7H_2O$, 45 g $NiCl_2 \cdot 6H_2O$ and 30 g H_3BO_3 are dissolved in pure distilled water to make 1 l.

(9) *Standard Lead Solution—10 micrograms per milliliter.*

Dissolve 100 mg pure test lead in 2 ml HNO_3. The lead nitrate is transferred to a liter flask with thorough rinsing of the 50 ml beaker in which the lead is dissolved. Add 5 ml glacial acetic acid, dilute to the mark with lead free water and mix well. Dilute 10 ml of this solution to 100 ml. The diluted solution contains 10 gamma lead per ml. Lead acetate or lead nitrate may be used for preparing the standard lead solution, but because of uncertainty in regard to the amount of moisture and water of crystallization the salts may contain, it is best to use pure lead.

APPARATUS REQUIRED

(1) pH meter or its equivalent.

(2) Two 60–100 ml short stemmed separatory funnels (Squibb Type).

(3) Pipettes and burettes.

(4) Colorimeter: Klett-Sommerson with green filter No. 54 or any other photoelectric colorimeter.

PROCEDURE

For routine control work, the following procedure should give satisfactory results if closely followed.

Adjustment of the pH

(1) Transfer 1 ml of the plating bath to a separatory funnel. (Note 1.)

(2) Add 10 ml of the sodium tartrate solution.

(3) Add 6 drops of concentrated NH_4OH—more if needed. (Note 2.)

(4) Add potassium cyanide from a burette until the solution is straw colored—with the usual amounts of impurities present, 12–13 ml should be enough. If the nickel bath contains more nickel than the bath used in this investigation, increase the amount added. If there is any trace of a greenish color, add more reagent.

(5) Measure the pH of the solution with a pH meter and if it is not between 8.5 and 9.0, add tartaric acid or NH_4OH from a dropping bottle until it is properly adjusted. If thymol blue indicator is used, add 5 drops of it at this point and adjust the acidity until the solution is greenish in color.

Isolation of the Lead

(6) After the pH has been adjusted, add 5 ml of dithizone solution from a burette, shake for 30 seconds, allow the layers to separate, and run the solvent layer into another clean separatory funnel.

(7) Repeat the extraction with 2 ml portions of dithizone until the dithizone remains green in color. This indicates that all the lead has been extracted.

(8) Add 5 ml of pure carbon tetrachloride and again shake for 30 seconds. Combine this extract with those made with dithizone.

(9) Add 20 ml of alkaline potassium cyanide solution to the combined extracts.

(10) Shake for 30 seconds, allow the layers to separate, and draw off the carbon tetrachloride layer into a 25 ml volumetric flask.

(11) Dilute this solution with pure solvent to the mark and shake well.

Measurement of the Transmittancy of the Lead Dithizonate

(12) Filter the solution through a clean Whatman No. 40 paper moistened with carbon tetrachloride. Catch the filtrate in a clean, dry erlenmeyer flask. (Note 3.)

(13) After the instrument has been adjusted with pure carbon tetrachloride as the reference liquid, transfer a portion of the filtrate to a matching test tube. Rotate the dial until the galvanometer needle returns to the zero position and record the scale reading. If the instrument has a wave length scale, set it for 520 millimicrons.

(14) Run a blank, going through the above procedure with the same number of dithizone extractions as were required to extract the lead. Record the scale reading of the blank. (Note 4.)

(15) Subtract the blank reading from the sample reading. Record this corrected scale reading and, on the calibration curve, read the amount of lead in the sample taken for analysis. (Note 5.)

Notes on Recommended Routine Procedure

NOTE (1). The calibration curve is prepared for amounts of lead up to 50 gamma per 25 ml of solution. This is equivalent to 2 ppm. If tests show that more than this amount of lead is present, a smaller aliquot of the plating bath must be taken. This can be done by using a pipette graduated in fractions of a milliliter or by diluting 1 ml of the plating bath to 50 or 100 ml and then taking a suitable aliquot of the diluted solution. In any event, the aliquot taken for analysis should not contain more than 50 gamma of lead unless the calibration curve is extended.

NOTE (2). If 6 drops of ammonium hydroxide is not enough to make the solution distinctly ammoniacal, add more. Avoid a large excess.

NOTE (3). The purpose of the filtration is to remove water droplets that are suspended in the carbon tetrachloride layer. If this is not done, droplets are soon found on the

sides of the test tube cell and will likely affect the light transmittance of the solution. Filtration does not seem to affect the lead color in any way.

NOTE (4). In running the blank it is essential to use as many extractions with dithizone as in running the regular sample. The reading on the blank increases as the number of required extractions increases. This may be due to incomplete removal of the excess dithizone by the alkaline KCN or to the presence of some diphenylthiocarbodiazone despite purification. It is quite possible that some substances present may also oxidize the dithizone. Ferric iron, for example, readily oxidizes it. This method of correcting for the blank can only be employed when the instrument has an extinction scale or one related to the extinction as explained in the general notes.

Calculations

Suppose that the corrected scale reading is 258. According to the calibration curve, the reading corresponds to 40 gamma of lead. If 1 ml of the bath is taken for analysis, then 40 x 1000 = 40,000 gamma or 40 ppm of lead is present in the bath. This is equal to 0.040 grams per liter.

If a solution is known to transmit light in accordance with Bouguer-Beer's law and the instrument has a logarithmic scale, it is possible to eliminate the need for a calibration curve.

An example will make the method clear. Run an unknown and a standard sample, simultaneously treating each exactly the same. Get their scale readings and correct for blanks as described above. Since the readings for both the standard and unknown are directly proportional to the concentration if the Bouguer-Beer's law holds, the concentration of the unknown is calculated by the use of the following formula:

$$\frac{\text{concentration of standard}}{\text{corrected reading of standard}} \times \text{reading of unknown} = \text{concentration of unknown}$$

Suppose, the standard contains 20 gamma of lead and has a corrected reading of 137. The unknown—using 1 ml of plating bath—gives a corrected reading of 175. Substituting these numbers into the above formula, the amount of lead in 1 ml of the bath under test is (20/137) x 175 = 25.9 gamma. Hence, in one liter there is 25.9 x 1000 = 25,900 gamma = 25.9 ppm or 0.0259 gram of lead per liter.

Once the standard has been run, it is not necessary to run it with each unknown—although it would be desirable—since $\frac{\text{concentration of standard}}{\text{corrected reading of standard}}$ is a constant. It would only be necessary to multiply the scale reading of an unknown by this constant factor to get the concentration of lead in the unknown.

A "Stop and Go" Method for Lead

A "stop and go" method may be roughly defined as one that in a short time will give the analyst an approximate idea of the amount of lead in the solution.

If the pH of the solution has been adjusted correctly, the number of extractions required to remove all the lead can serve as a stop and go method.

PROCEDURE

(1) Follow the recommended routine procedure up to and including step (5).

(2) After the pH has been adjusted, add 2 ml of dithizone solution from a burette, shake for 30 seconds, allow the liquid layers to separate, and run the lower layer into another clean separatory funnel.

TABLE VI

Estimation by Appearance of Extract

No. of Dithizone Extractions	Lead Present gamma	Notes
2	10	
3	20	2nd extract almost green
3	30	2nd extract definitely purple
4	40	3rd extract almost green
4	50	3rd extract definitely purple

(3) Continue the extractions with 1 ml portions of dithizone, recording the number of extractions required including the first one until the dithizone remains green in color.

(4) The amount of lead present in the sample can be estimated by reference to Table VI.

NOTE (a). It must be emphasized that this method will work only if the pH of the solution is between 8.5 and 9.0.

NOTE (b). By noting the various shades of purple of each extract, an operator will quickly be able to estimate the lead content of a sample within 10 gamma without much difficulty.

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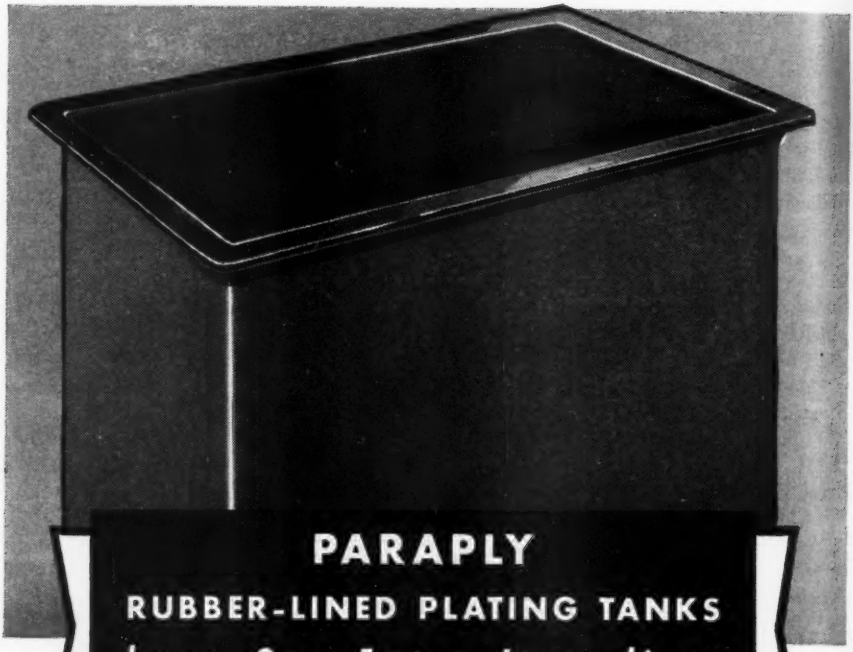

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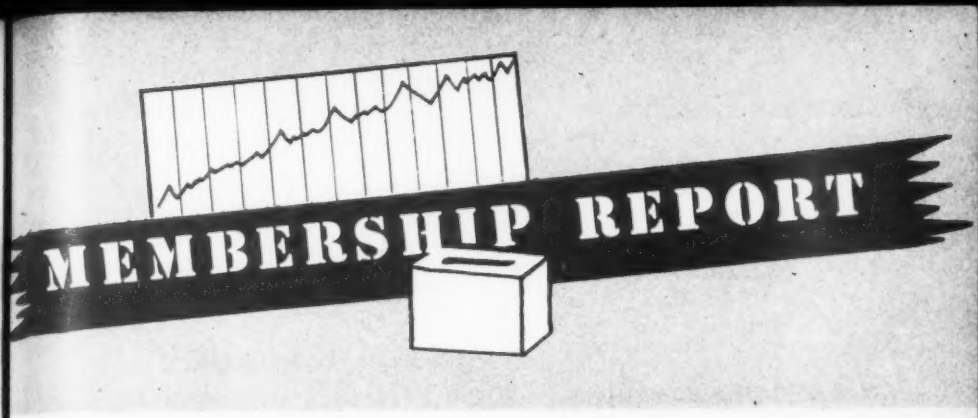

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James M. Overton, Box 274a, RFD Towne St., Attleboro, Mass.

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William F. Witt, 4 Woodrow Ave., Vallejo, Calif.

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A. J. Christian, 966 Pryor St., Atlanta, Ga.

C. L. Estes, 625 N. Highland, Apt. B-11, Atlanta, Ga.

E. G. Estes, 219 Pryor St., Atlanta, Ga.

S. M. Grandy, 155 Coventry Rd., Decatur, Ga.

A. J. Hereford, 465 Ponce de Leon Ave., N. E., Atlanta, Ga.

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E. J. Slemons, 146 Carolina Ave., Spartanburg, S. C.

D. A. Smith, 634 Anton St., S. W., Atlanta, Ga.

P. J. Stephens, c/o Southern Plating Co., Atlanta, Ga.

H. R. Stogner, Atlanta Plating Works, 1078 Washington St., Atlanta, Ga.

Clyde Stovall, Scripto Mfg. Co., 423 Hooston St., N. E., Atlanta, Ga.

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G. H. Wilkinson, Rte. 3, Box 195, Pensacola, Fla.

C. M. Woolfolk P. O. Box 67, Tarrant Branch, Birmingham 7, Ala.

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Walter Jenski, 1741 N. Hermatage Ave., Chicago 22, Ill.
Edwin A. Stack, 1943 Walnut St., Chicago 12, Ill.
Edward Witkowski, 5237 W. Newport Ave., Chicago 41, Ill.

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John Peter Roos, 178 Renner Ave., Union, N. J.

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Irving Kavovit, Keystone Silver Co., New York, N. Y.

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G. Albert Poole, Poole Silver Co., Taunton, Mass.

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Allen S. Brumm from Jackson-Lansing Branch to Toledo Branch
M. S. Siddall from Jackson-Lansing Branch to St. Joseph Valley Branch
A. C. VanSchelt from Milwaukee Branch to Cleveland Branch
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John Glover
Arthur J. Mail
Robert Veitch

REINSTATEMENTS

INDIANAPOLIS BRANCH
R. M. Wagner

NEW YORK BRANCH
William Fischer

DEATHS

BOSTON BRANCH
Wesley Colby

CHICAGO BRANCH
Jacob Mintz

NEWARK BRANCH
Robert Doherty

MAGNETISM AND THICKNESS GAGE

(*Continued from Page 1045*)

The extreme variations from the average are now similar in magnitude to those obtained for the actual thickness of the plated coating and must therefore be regarded as real thickness variations.

The table shows that a plate does not have to be completely demagnetized before the magnetic gage can be used with accuracy for either local or average thickness. From other data, it has been found best not to demagnetize completely since the poles of the plate may then shift and give a magnetic effect at right angles to the original magnetic poles.

From the uniformity of the readings obtained with low degree of magnetization, it was agreed that a compass deflection of not over 15° at 3.0 cm was satisfactory basis for accurate readings. This procedure takes less time than would be required to completely demagnetize the plate.

Because of the difficulty in demagnetizing a large, irregularly shaped object, magnetic gage readings have been taken at the magnetically neutral center of the piece. In view of the close agreement between the values for the center of the plate and the average as reported in Table I, this procedure appears to be justified.

Ample experimental data confirm that reported in Table I and justify further the conclusions drawn here.

MEMBERSHIP CHART

BRANCH	May 1946	Change in Membership	Per Cent Change
FIRST GROUP			
NEW YORK	201	+ 17	+ 8.5
PHILADELPHIA	170	+ 14	+ 8.3
BRIDGEPORT	124	+ 9½	+ 7.7
CHICAGO	359	+ 12½	+ 3.5
HARTFORD	134	+ 4	+ 3.0
WATERBURY	128	+ 2½	+ 2.0
TORONTO	131	+ 2	+ 1.5
BOSTON	168	+ 2½	+ 1.5
LOS ANGELES	181	+ 2½	+ 1.4
CLEVELAND	177	− 1½	− 0.8
NEWARK	243	− 8	− 3.3
DETROIT	440	− 37½	− 8.5
SECOND GROUP			
INDIANAPOLIS	90	+ 10	+ 11.1
PITTSBURGH	97	+ 8½	+ 8.8
PROVIDENCE-ATTLEBORO	122	+ 7	+ 5.7
DAYTON	87	+ 3	+ 3.4
BUFFALO	87	+ 1	+ 1.1
SPRINGFIELD	82	....	....
BALTIMORE-WASHINGTON	114	....	....
GRAND RAPIDS	116	....	....
ST. LOUIS	122	....	....
ROCHESTER	97	− 1	− 1.0
MILWAUKEE	120	− 3	− 2.5
NEW HAVEN	110	− 3	− 2.7
SYDNEY	82	− 6	− 7.3
JACKSON-LANSING	85	− 32½	− 38.2
THIRD GROUP			
ADELAIDE	37	+ 12	+32.5
SAN FRANCISCO	64	+ 9	+ 14.0
SYRACUSE	64	+ 5	+ 7.8
ST. JOSEPH VALLEY	60	+ 3	+ 5.0
COLUMBUS	34	+ 1	+ 2.9
LANCASTER	38	+ 1	+ 2.6
MELBOURNE	59	+ 1	+ 1.7
TWIN CITY	72	+ 1	+ 1.4
TOLEDO	60	+ ½	+ 0.8
ROCKFORD	53	....	....
CINCINNATI	58	− ½	− 0.9
MONTREAL	61	− 5	− 8.2

Membership May 1, 1946: 4,527
Membership September 15, 1946: 4,576

Gain in Membership: 49
Per Cent Gain: 1.1

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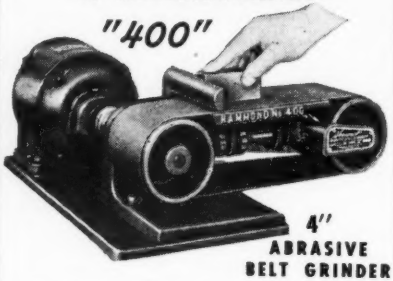

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National Metal Congress and Exposition

W. H. Eisenman, Secretary of the American Society for Metals, announces that the National Metal Exposition and Congress will be held in the Municipal Auditorium in Atlantic City on November 18–22. Not less that 180,000 square feet of exhibit space is available.

A WESTERN METAL CONGRESS, the fifth since its inception, will open about March 22, 1947, in San Francisco.

Electrotypers & Stereotypers To Hold Convention

A. P. Schloegel, Executive Secretary, announces that the 49th Annual Convention of the International Association of Electrotypers and Stereotypers will be held on October 9–11 in French Lick Springs Hotel, French Lick, Indiana.

All speakers who have been selected to address the convention have prepared papers of interest to the industry.

An excellent entertainment program has been prepared for both men and women.

1946 Proceedings Delayed

Because of the paper shortage, it has become necessary to delay the publication date of the 33rd Annual Proceedings.

It is hoped to have them in the mails by November.

The price has finally been set—$6.50 per copy.

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Detroit 1947 Convention City

When Montreal hotels found themselves unable to receive the 33rd Annual Convention of the American Electroplaters' Society, the Detroit Branch kindly stepped into the breach and issued an invitation to come to Detroit. This offer has now been accepted, thirty-seven out of thirty-nine Branches replying, having approved the selection.

Statler Hotel again will be Convention Headquarters.

The date is June 23–26.

Make your plans to attend now.

By DR. HAROLD J. READ
Associate Professor of Metallurgy
The Pennsylvania State College

FLOW METER ENGINEERING HANDBOOK, by Louis Gess and R. D. Irwin, 2nd Edition, 1946, VIII + 151 pages. The Brown Instrument Co., Philadelphia, Pa. Price, $2.50.

This book is not a treatise on the general subject of flow meter engineering, but, rather, a monograph on the use of the orifice type of meter. This is not a particularly objectional restriction in itself since the vast majority of flow meters operate on the principle of measuring the pressure drop across an orifice. But it must be recognized that there are available other meters such as those of the area type which are not mentioned in this handbook. The title would, therefore, have been much more accurately descriptive if it had contained the word "orifice".

All descriptive examples of mechanisms, apparatus and equipment are based on items manufactured by the Brown Instrument Co. The illustrations fall into the same category. On the other hand, however, the volume is in no sense a glorified catalog or overgrown sales brochure.

Within the limitations set forth above, the handbook is a well-organized and clearly written presentation of the chosen subject matter. Speaking as a bibliophile, this reviewer is eager to express his appreciation of the excellent job of book making—the typography, format, paper and binding are all first rate. It is evident that much thought and care have been expended on the preparation of the handbook.

Of the sixteen chapters which comprise the volume, the first three are devoted to discussions of the principles of orifice meter measurement and the design of equipment to utilize these principles. The succeeding eleven chapters present a variety of pertinent information on the flow of gases and fluids, while the concluding chapters are concerned with corrections for changes in operating conditions and volume computations.

Of necessity a few mathematical expressions are used from time to time. Nothing beyond a knowledge of simple algebra is required of the reader and by far the greater part of the book may be used without even this background. There are tables, graphs and nomographs which almost entirely remove the necessity for making any but the simplest of calculations.

In addition to all the other tables relating to the many factors which affect flow measurement, there is a particularly valuable collection of orifice coefficient tables. Forty-five pages of tables give the coefficients for three kinds of taps (vena contracta, flange and pipe) for pipe sizes from 2 to 14 inches, based on tables and curves from the report of the Joint A. S. M. E.–A. G. A. Committee.

Everywhere in the book, a nice balance is preserved between the discussion of theory and practical application. While the arm-chair theorizer would not be satisfied and a plumber might be puzzled, the practical plant man who wants to know both "how" and "why" will find what he desires.

The modern electroplater who measures steam flow to heating coils, water to rinse tanks, circulation through filters, etc., will find much of interest in Gess and Irwin's contribution to the literature of instrumentation.

By KENNETH M. HUSTON

Chairman, Program and Educational Committee

Modified Chromic Acid Anodizing Process for Aluminum

C. J. SLUNDER and H. A. PRAY. *Ind. Eng. Chem.*, **38**, 592–596 (June 1946).

A wartime shortage of chromic acid made necessary a study of chromic acid anodizing by a process in which bath maintenance is achieved by sulfuric acid additions. The sulfate content of such baths introduces corrosion difficulties when steel tanks are used. However, with protected tanks and carbon cathodes and by control of the operation on the basis of anode current density, the process appears from the laboratory test to offer promises of a considerable saving in chromic acid consumption. The relations between current density, voltage, sulfate content and coating weight are described.

•

Industrial Electrolytic Polishing

R. HALUT and P. ROCQUET. *Galvano*, No. 111, 8 (1946).

Electrolytic polishing gives an absolutely smooth surface free of oxide inclusions often present on apparently smooth surfaces obtained by ordinary mechanical polishing. It constitutes an excellent preparation of a surface for electrodeposition, especially for bright plating. Electrolytic polishing before the last stages of rolling or drawing gives a more perfect and brilliant surface. The chief requirement for the application of electrolytic polishing is a homogeneous alloy containing few impurities.

J. S. FRITZ.

•

Removing Sand Scale from Gray Iron Castings

ANON. *Iron Age*, **157**, 51 (May 16, 1946).

Successful use of the duPont sodium hydride descaling process for removing sand and scale from gray iron oil pump bodies and parts is reported by a large Midwestern plant.

•

Tinning of Cast Iron

R. A. CRESSWELL. *Foundry Trade Journal*, **78**, 435–439 (April 25, 1946).

Describes methods of hot-tinning cast iron directly, *i. e.*, without the application of an intermediate metal coating. Influence of modifications in the successive stages of cleaning, pickling, fluxing and tinning was first studied. Later it was found that better tinning was obtained by preparing the cast iron for tinning by treatment in fused salts.

Applied Finishes for Zinc Alloy Die Castings

ANON. *Product Engineering*, **17**, 389–393 (May 1946).

Discussion of some organic, plastic, electrolytic and chemical immersion finishes applicable to zinc alloy die castings. Appearance, commercial adaptability and general utility are considered as well as methods of application, limitations and practical uses.

●

Finishing Clinic

ALLEN C. GRAY. *Products Finishing*, **10**, 50–62 (May 1946).

Future possibilities in protective coatings from plastics; porcelain enamels can be sprayed electrostatically; cleaning magnesium; surface finishing of berrylliumcopper alloys; a new process for scale removal from stainless steels; thickness determination of terneplate coatings.

●

The Electrolytic Polishing of Metals

PAUL SCHAFMEISTER and KARL ERICH VOLK. *Arch. Eisenhuttenwesen*, **15**, 243–246 (1941); *J. Inst. Metals*, **13**, 163 (May 1946).

Electrolytic polishing is reviewed in general terms with reference to the work of many investigators. Suitable electrolytes for the polishing of aluminum, lead, cobalt, copper, iron, steel, alloy steels, tungsten, zinc and tin are discussed, and essential details, such as composition of electrolyte, current density and time and temperature of polishing are summarized in a table. Comparisons are made between mechanically and electrolytically polished specimens of various materials and illustrated with photomicrographs. It is concluded that for homogeneous materials electrolytic methods give the best surfaces while heterogeneous specimens are best prepared by mechanical means because of the tendency of particles of a second phase to dissolve out during the electrolytic process. Reference is also made to the fact that electrolytic polishing produces no deformed layer on the surface. Hence it may be used with advantage where surface deformation causes structural changes to occur.

●

Gel Lacquers Provide New Coating Method

ANON. *Chemical Industries*, **58**, 776–777 (May 1946).

Describes a way to apply a durable "plastic veneer" by dipping articles in a gel-forming cellulose ester lacquer.

●

Sodium Hydride Descaling

E. L. CADY. *Materials and Methods*, **23**, 1278–1283 (May 1946).

Experience in stainless and alloy steel mills points to the use of this new process for many descaling, deoxidizing and skin softening tasks.

●

Electrolytic Copper and Chromium Plating of Silumin

K. P. BATASHEV and T. P. TATARNIKOVA. *Trans. Leningrad Ind. Inst.*, Sect. Met., No. 4, 105–114 (1940); *C. A.* **40**, 2745 (May 20, 1946).

Etching reagents of various compositions were investigated to insure satisfactory adhesion of electrolytic deposits on silumin (an aluminum alloy with 5 to 14 per cent silicon and some magnesium and manganese) which was sandcast, machined, and degreased cathodically in molar caustic soda at 5 amperes per square decimeter and 20–26° C for 5 minutes. Adhesion proved to depend directly on the quality of the etch. Salt spray tests showed that only the copper corrodes with non-porous copper plate, but that with even slightly porous copper deposits the underlying silumin will corrode within the first 24 hours. Consequently, copper plating offers no protection against

corrosion. Chromium plated samples withstand corrosion in salt spray for 5 to 15 days and show no corrosion on immersion in sea water for 30 days. Copper plated samples (thickness of deposit from 50 to 150 μ), tinned and soldered to steel show high adhesion of the plate; the rupture occurs at the soldered surface. Best solder composition in this case is 50 per cent tin plus 50 per cent lead. Preliminary electrolytic zinc plating experiments also gave positive results.

●

High Speed Production Metallizing

L. E. BROWNE. *Steel*, **118**, 93, 148, 150 (May 13, 1946).

A St. Louis company makes effective use of heavy duty metal spraying gun on pump plungers and tank interiors. Performance in continuous operations is distinguished by greater volume of metal deposited and reduced consumption of gases.

●

Contribution to the Study of Anodic Treatments

EMILE BARET. *Galvano*, No. 107, 13 (1945).

The protection of the surface of aluminum and its alloys by anodic oxidation in a sulfuric acid bath is considered and the mechanism is explained. Formation of aluminum sulfate is regarded as necessary for the formation of a proper surface of aluminum oxide. The author regards the practice of adding aluminum sulfate to a fresh bath as being without either theoretical or practical value.

J. S. FRITZ.

●

Passivity of Metals

JACQUES LIGER. *Galvano*, No. 111, 10 (1946).

The heat from polishing operations causes the formation of a thin, invisible oxide layer which will render a metal surface passive if not completely removed by thorough buffing. Alkali cleaning baths will passivate surfaces unless a current is flowing. Objects taken from the cleaning bath should be rinsed in fresh, flowing water. After rinsing, the objects should be placed immediately in the plating bath and not left in contact with the air. (EDITOR'S NOTE: An acid dipping treatment would help.)

J. S. FRITZ.

●

Thickness Measurement of Thin Coatings by X-Ray Absorption

H. FRIEDMAN and L. S. BIRKS. *Review of Scientific Instruments*, **17**, 99–101 (March 1946).

A method is described for determining the thickness of thin coatings on crystalline bases by means of X-ray and Geiger counter, both situated on same side of the coating. The X-rays pass through the coating and are reflected at Bragg diffraction angle from base back to the counter, their intensity being reduced by absorption due to double transmission through coating. The thickness of coating is computed from the measured absorption. The method is applicable to coating thicknesses in range 0.00001 to 0.01 centimeter (0.0000025 to 0.0025 inch).

●

Chemical Conversion Coatings

G. W. JERNSTEDT. *Metal Industry*, **68**, 407–409 (May 24, 1946).

Surface conversion coatings on copper and brass, aluminum, magnesium, zinc and cadmium are described. Existing procedures for producing the coatings are discussed and the characteristics of the coatings formed are examined. Tendency today is towards the development of finer-grained, more flexible finishes so that the coated metals may be formed to the finished part.

Rustproof Coating

ANON. *Steel*, **118**, 155 (May 6, 1946).

A new rustproofing technique for steel and galvanized steel which deposits a coating of from 0.000005 to 0.0000015 inch will protect stock during manufacturing stages and permit a tighter bond with paints. It consists of a glassy metal phosphate, so plastic that it will bend with the steel or permit die-stamping without harm to the coating.

●

Effect of Composition and Environment on Corrosion of Iron and Steel

C. P. LARRABEE. *Corrosion and Material Protection*, **1946**, No. 4, 18.

"Atmospheric corrosion resistance" is considered to be a direct function of the type of rust that is formed during the first year or so of exposure. The physical nature of this rust depends to a large extent on composition of the steel and the conditions under which the rust is formed. There is a direct relationship between roughness of rust and corrosion. After six months to one year's exposure, an approximate separation of ferrous materials into classes may be made by the roughness of the rust, also by its color: the darker the color, the more protective the oxide. Rust formed in a marine atmosphere is not as protective as that formed at an industrial location, probably because of the effect of chlorides on the rust. Data obtained from steels having a very low residual amount of copper, phosphorus, silicon and nickel show that only a slight increase in the percentage of some of these elements is required to decrease the loss of weight (increase the corrosion resistance) when the given steel contains 0.5% or more of chromium. The addition of small amounts of alloying elements, unfortunately, does not yield increased corrosion resistance, even if the water be relatively pure. The results of many immersion tests in sea water show that the average penetration (calculated from losses of weights) of most plain and low alloy steels and irons is about 0.0004 in. per year. As in fresh water, chromium steels in sea water exhibit less overall corrosion than plain steel, but the tendency to pitting attack is increased unless precautions are taken to prevent precipitation of chromium carbides.

L. H. SEABRIGHT.

●

Chemical Black and Color Finishes for Metal

ARTHUR P. SCHULZE. *Industrial Finishing*, **22**, 44, 46, 48, 50, 52, 54, 56 (May1946).

Durable corrosion-resistant black finishes for bright clean iron, steel, zinc and cadmium surfaces as well as black and color finishes for copper and brass alloys are produced by immersion in hot solutions of chemicals. They serve as final finishes with glossy or matte luster, or as good undercoats for paints, varnishes, lacquers or synthetics.

●

Organic Coatings for Magnesium

HOWARD E. SMITH, JAMES E. CREAGER, R. DONALD WEIR and JOSEPH WARD. *Organic Finishing*, **7**, 31-33, 36-40, 45 (May 1946).

Current finishes for magnesium fall into four classifications: wrinkle finishes, gloss finishes, eggshell or semi-gloss finishes, and flat or lustreless finishes. Few of the general characteristics of these new finishes are noted.

●

Production Metallizing Speeds Aircraft Engine Output

H. E. LINSLEY. *Industrial Gas*, **24**, 11-12 (May 1946).

Through close co-operation between machine manufacturers and the methods engineers of the Wright Aeronautical Corporation, a procedure has been worked out for handling the complete metallizing operation on a line production basis in less than eight per cent of the time formerly required.

The Significance of Water in the Plating Room

ZACHARY IRENAS. *Metal Finishing*, **4**, 195–197 (May 1946).

Stresses the importance of using purified water for plating baths.

●

Silvering of Plastics

HAROLD NARCUS. *Metal Finishing*, **44**, 240–242 (June 1946).

Practical procedures are described for commercial production of electrodeposited coatings on plastic to meet new demands in electrical and electronic equipment fields. Costume jewelry is an established application of the process. 16 references.

●

Plating Die-Castings (Concluded)

E. A. OLLARD and E. B. SMITH. *Metal Industry*, **68**, 366–368 (May 10, 1946).

Describes methods now in use for applying the final chromium on the zinc base die-castings, prepared by means of a copper coating by a nickel plate. Silver, speculum, and bronze finishes are also discussed.

●

Corrosion Primer—Atmospheric Corrosion

ANON. *Corrosion and Material Protection*, **1945**, No. 6, 19–22.

In atmospheric corrosion we are dealing with two sets of factors: (1) the constituents of the atmosphere and (2) the character of corrosion products formed. From the standpoint of moisture content of the air, three conditions are possible: unsaturated, saturated and supersaturated. If the relative humidity is high from the start, no opportunity is afforded for the primary film to form sufficiently slowly to be protective. If the humidity is low at the start, the primary film is gradually strengthened and becomes definitely protective. As the humidity is increased, a critical concentration is reached at which there is a rapid increase in corrosion. The critical humidity is between 43 and 68%, probably around 60–65%. The atmosphere contains as impurities sulfur dioxide and carbon dioxide in significant amounts and in special cases, ammonia, hydrogen chloride and hydrogen sulfide. Carbon dioxide is definitely repressive in atmospheric corrosion. Intrinsically active solid particles as represented by ammonium sulfate accelerate corrosion, but when traces of sulfur dioxide is present, there ensues a tremendous acceleration. Intrinsically neutral particles such as silica have no appreciable effect as long as they do not have the power to absorb gases. Under supersaturated conditions, moisture is present on the surface and corrosion is greatly accelerated. In considering non-ferrous metals, three types of corrosion products have been distinguished: (1) a continuous transparent film in optical contact with the metal which gives rise to interference colors, as in the tarnishing of copper and silver, (2) a granulated structure which allows free access of the atmosphere to the metal as yielded by zinc, (3) an impervious product which causes the corrosion curve to resemble a parabola in the beginning and quickly flatten toward the time axis. This type of curve is obtained with aluminum and lead and indicates a highly protective film.

L. H. SEABRIGHT.

●

The Potentiometric Micro-Determination of pH. Part II

J. T. STOCK and M. A. FILL, *Metallurgia*, **33**, 271–272 (Mar. 1946).

Various types of glass electrodes are discussed. 11 references.

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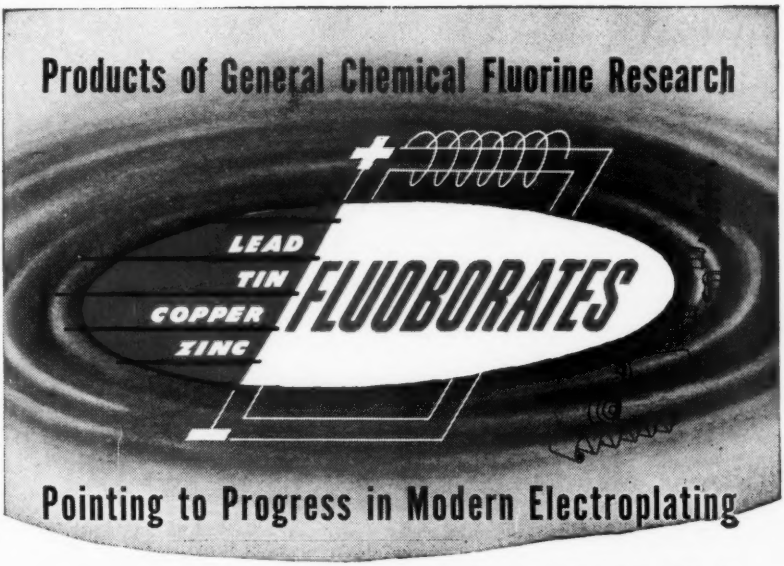
Ceramic Calculations Table

W. C. HANSARD. *American Ceramic Society Bulletin*, **25**, 207-208 (May 1946).

Simplifies calculation of glazes, frits, glasses and enamels.



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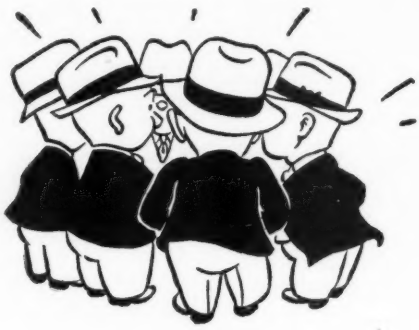

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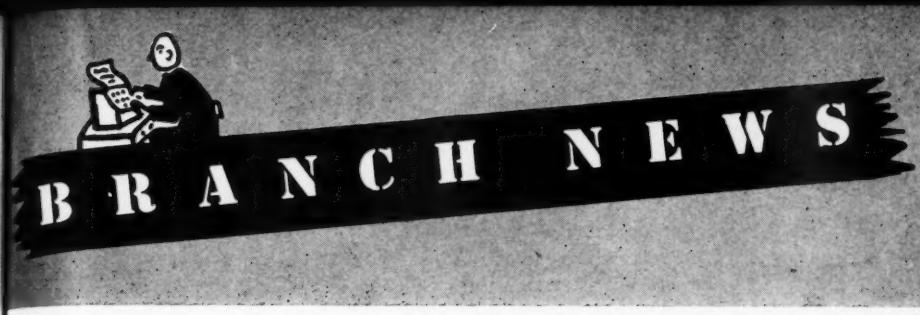

NEW HAVEN BRANCH

New Haven Branch held its last meeting of the season in the Hotel Taft on May 5th. The meeting was called to order by President WALTER T. LYNCH promptly at 8:30 P. M.

The principal business of the evening was the election of officers for the coming year. C. GARNER, Chairman of the Nominating Committee, brought in a slate of candidates which was unanimously approved by the members. The new Officers are:

President—JOSEPH M. COOKE, International Silver Co., Meriden, Conn.

Vice-President—EDGAR W. LUTHER, Underwood-Fisher Co., Hartford, Conn.

Secretary-Treasurer—BERNARD J. GAFFNEY, Sargent & Co., New Haven, Conn.

Librarian—C. FRED GURNHAM, Whitney-Blake Co., Hamden, Conn.

Assistant Librarian—HENRY B. SMITH, R. Wallace & Sons, Wallingford, Conn.

Board of Governors—CLARENCE GARNER, International Silver Co., Meriden, Conn.; JOSEPH L. DOWNES, Andower Kent Co., Middletown, Conn.; and WILLIAM F. BRIDGETT, H. L. Judd Co., Wallingford, Conn.

Technical Chairman DR. C. F. GURNHAM introduced the speaker, Mr. E. H. BUCY of the Zapon Division of the Atlas Powder Co., who spoke on "War Developments in Organic Finishes." Mr. Bucy's subject covered urea formaldehyde and melamine resin coatings, wrinkle and hammer coatings, and new raw materials for the formulations of organic coatings. This valuable information was well received by every finisher present.

B. J. GAFFNEY, *Secretary-Treasurer.*

CHICAGO BRANCH

The regular monthly meeting of the Chicago Branch was held at the Atlantic Hotel on Friday, August 9th.

RUDY HAZUCHA, one of the strongest supporters the Society ever had, marked his 31st year of perfect attendance, never having missed a regular meeting.

The educational meeting was excellent. It was what the founders had in mind when the Society was formed, namely, an interchange of ideas among the members.

The topic for discussion was "Barrel Nickel Plating." Our Librarian, Marion Longfield, presented a short paper on the subject in which he included requirements for the production of good parts, nickel plated in barrels. He touched on many details discovered during his long experience with this type of work.

The items discussed were methods of cleaning, construction of the plating barrel itself, materials found satisfactory for construction, the type of contacts best suited to different types of work, size of the load, permissible current densities, solution analysis and control, testing for thickness of deposit, purification, speed of barrel rotation, use of wetting agents, tank linings, effect of impurities, maintenance of equipment, so called laminated deposits, bath temperature, anodes and anode area, use of proprietary bright nickel plating solutions, and a good many other interesting points. We had an attendance of about 90 members and most of them took a very active part in the discussion.

The following questions in the Question Box were answered in the previous discussion.

Q. 1—Will a high chloride bright nickel

solution do a satisfactory job of plating in a barrel?—A. Yes.

Q. 2—Are standard bright nickel baths satisfactory for barrel work?—A. Yes.

Q. 3—Does laminated plate occur in barrel plating?—A. Yes, but under proper conditions of control is not harmful.

Q. 4—Is copper striking necessary for barrel nickel on steel?—A. No.

G. STUART KRENTEL, *Review Correspondent.*

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JACKSON-LANSING BRANCH

A Board of Directors Meeting was held on July 17 at the home of R. W. REDMOND.

WILLIAM H. BENNETT'S resignation as Secretary-Treasurer because of press of personal business had to be accepted and U. J. FORSYTH was appointed to serve out his term.

A discussion relative to holding all meetings in Lansing brought forth the consensus that attendance at meetings would be increased, a larger group of cities would supply membership, and in general the Branch would be benefitted thereby. The action was taken although it was regretted that it might impose some hardship on a few loyal members in the Jackson vicinity. It was thought best not to change the charter at this time.

PRESIDENT BENNETT instructed the Librarian to make necessary arrangements for holding all future meetings in Lansing, and the Secretary to notify the Executive Secretary so that the meeting place may be changed in the Monthly Review.

A review of the membership was made and those in arrears with dues are to be suspended.

R. W. REDMOND was instructed to use the net receipt from the Annual Party in February to purchase a movie projector screen and microphone and necessary attachments for their operation.

V. J. FORSYTH, *Secretary-Treasurer.*

●

SAN FRANCISCO BRANCH

The August meeting was held at Victor's and Roxie's Cafe in Oakland on Thursday the 8th. Nineteen members and two guests attended.

A vote was taken on the emergency selection of a city for the 1947 National Convention. A resolution was passed naming Los Angeles as the first choice of this Branch and Detroit as second choice.

Resignation of N. C. PHILLIPS as Librarian, was accepted and ARTHUR KISTLER was elected to replace him in office.

It was decided to inform all members delinquent in membership dues for more than one year that they would be suspended unless they have arranged payment by the next meeting.

One application for membership was received and unanimously approved by the members present.

Open Forum Discussion was held on plating problems of the members. Topics brought up were pitting of nickel deposits and a comparison of the characteristics of the du Pont Hi-Speed Copper and Unichrome Copper processes.

One of the Branch Honorary Members, SAM HERRICK, now retired from active participation in the industry, displayed a new hybrid cucumber, 14 inches long, which he has developed.

FRED W. HUNTINGTON,
Secretary-Treasurer.

●

SOUTHEASTERN BRANCH

The regular monthly meeting was held at the Robert Fulton Hotel in Atlanta on August 8, with seventeen members in attendance.

The meeting was called to order at 8:30 P. M. after a very good steak supper, DURWOOD SMITH being responsible for the supper arrangements.

Since JOHN MORRIS has so far been unable to attend meetings or take any active part in the activity of the Branch, our good friend CHARLES WOOLFOLK of Birmingham was unanimously elected to take his place and was given a rising vote of thanks for his sincere cooperation with the Society and what it stands for.

Publicity was discussed first by M. E. AWTRY who stated we will get a page in the *Atlanta Journal* magazine section. A general discussion followed as to the relative value of a local paper and publications such as Textile World and Southern Power and Industry.

H. R. STOGNER brought out the fact that if the manufacturers producing a new article which necessitates polishing or plating would be a bit more cooperative with the platers and consult with them before the designs of the product were finally decided upon, a much more satisfactory job could be obtained. Some little change in design could sometimes work wonders and would not affect the looks or quality of the product.

We all regret very much losing F. L. OLDRODE of Oakite Products who is being transferred to Chicago. We all wish him the best of luck in his new venture.

It has been suggested that our October meeting be held in Birmingham if convenient to our Birmingham friends. CLEM HOHNER will work out the details.

H. R. STOGNER, Manager of Atlanta Plating Works, was the speaker of the evening, his subject being "My Dream of the Ideal Plating Shop."—Picking the finish or finishes to specialize in—finding a place with desired floor space and facilities for expansion, not just a hole in the wall—buying good lathes, a good blower system and a good floor for the polishing room—buying polishing and buffing wheels in sufficient quantity and of designs which the operators like to work with—putting in acid proof floor in the plating room with good pitch for drainage and flushing and covering it with slatted mats to keep the operators' feet dry—getting cleaning and plating tanks a little larger than one thinks one will ever need and rinse tanks with plenty of clean running water and some sort of agitation—having a convenient layout with plenty of working space—acquiring power units to take care of present requirements plus—setting aside a room for repairing silver, well ventilated and with plenty of light—hiring satisfactory personnel, well educated by membership in the A. E. S.—just a dream that may come through some day.

WILLIAM T. WEYMOUTH,
Secretary-Treasurer.

●

SYDNEY BRANCH

The regular monthly meeting of the Sydney Branch was held on Tuesday, 13th of August, at the Chamber of Manufactures. In the absence of the President, Vice-President E. J. WRIGHT took the chair.

At the business meeting, three new members were elected and one application was referred to the Board of Managers. Librarian HEARD then took charge of the meeting and introduced the speaker of the evening, MR. E. J. WRIGHT from the Australian General Electric Company whose subject for the evening was "Metal Polishing." As this was the first talk on polishing, delivered to the Branch, it was well received by the 33 members and visitors present. Of particular interest was the speaker's description of the making of polishing wheels.

J. R. GODFREY, *Secretary-Treasurer.*

●

ADELAIDE BRANCH

The regular monthly meeting was held on Wednesday, 22nd of May, when President W. J. BLANCH presided over a meeting of 45 members.

A letter from the A.E.S. Executive Board advising that the Branch has been granted its permanent charter was read to the gathering which expressed its appreciation.

A letter from the Los Angeles Branch was received wishing the Adelaide Branch every success and granting the transfer of the President from Los Angeles Branch to Adelaide. It was decided to approach the Los Angeles Branch with a request that it consent to an annual exchange of a paper with the Adelaide Branch.

The speaker for the evening was one of our own members, MR. IVOR WILES, who gave a brief resume of aspects of war time plating in England as seen by him during his four years stay in that country. It proved most interesting to all present, and was followed by the showing of several movie films made during the period of his stay in Britain.

G. N. DIXON, *Secretary.*

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BOSTON BRANCH

The following new officers were elected at the annual business meeting on June 6:

President—ANDREW W. GARRETT
First Vice-President—L. V. GAGNON
Sec. Vice-President—ROBERT R. FLAHERTY

Librarian—L. CHESWORTH
Secretary-Treasurer—G. P. SWIFT
Board of Managers—E. CALLAHAN, H. GOLDBERG, H. SALTZBERG
Sergeant-at-Arms—M. GLOVER

The evening's speaker, MR. RALPH MCCAHAN of E. I. du Pont de Nemours & Co., Inc., had for his subject "Cyanide Plating Solutions, Particularly Copper and Brass." He covered the history of du Pont cyanide high efficiency copper baths, development of double salts of copper with potassium cyanides, comparisons between sodium and potassium baths, apparatus and methods of control, development of processes and cycles for plating on steel and die castings, wetting agents, and typical barrel plating solutions.

●

BRIDGEPORT BRANCH

Thirty-nine members and guests attended the regular monthly meeting on Friday, June 7, at the Hotel Barnum.

C. C. Helmle reported that the Branch had collected $91.50 from the members of the Branch during the fiscal year 1945–1946 and that a check for this amount had been forwarded to the Executive Secretary of the Society as a contribution to the Research Fund.

Regional Meeting delegates reported a very successful meeting at Hartford, Conn., on May 11. The Educational Session in the afternoon had fine papers resulting in very good discussions which were timed with fair accuracy. The Banquet and floor show were excellent and all who attended had a very good time.

C. L. TEMPLE, Chairman of the Membership Committee, reported one application for membership and six applications ready for election. They were elected later in the meeting. There was one resignation.

The Sick Committee reported that T. M. BARNES is ill in the hospital. F. KALAFUS reported that R. J. O'CONNOR is recuperating from a bad knee. We hope both will soon regain full health. It was also reported that the young son of our member ANTHONY J. CHENIS has passed away after a lingering illness. Our deepest sympathy and regrets go to the bereaved family.

In a letter our member HERBERT JUNE stated that the Electro-Lux Corp. of Old Greenwich, Conn., is willing to have our meetings anytime the Branch wishes. This kind invitation was turned over to Librarian CARL SCHAEFER for consideration.

President H. M. GOLDMAN appointed F. B. GOTTHARDT as Chairman of a committee to locate a suitable meeting place for our open meetings. Mr. Gotthardt is to name his committee and report at our September meeting. Librarian CARL SCHAEFER and Secretary J. G. STERLING will assist him.

It was agreed to hold the traditional outing sometime in September. The President appointed the following to the Committee: RAY J. KWASNIK, Chairman, WILLIAM EHRENCHRONA and FRED GOTTHARDT.

President H. M. GOLDMAN called for a Technical Session Period of Questions and Answers and named a board of Judges and Experts consisting of DR. W. R. MEYER, R. J. KWASNIK and J. E. CHARLESON who capably answered numerous questions.

JOSEPH G. STERLING,
Secretary-Treasurer.

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DETROIT BRANCH

Through the courtesy of the Ford Motor Company, three hundred members and friends of the Detroit Branch spent a very enjoyable and instructive two hours, Friday evening, September 6 at the mighty Rouge plant viewing the sleeve line and steel making operations.

We were met at the Rotunda by Ford buses which first transported us to the sleeve line where steel blanks are copper-plated, the copper to act as a lubricant during the subsequent drawing operations. After successive draws, several anneals and pickles, and final copper stripping, the cylinder sleeves are ready for tin plating on the outside diameter only, for the purpose of stopping off in the nitriding operation that follows. The inside surface is nitrided and honed to complete the job.

We then visited the steel plant where the Ford Company has in operation the

largest open-hearth furnace in the world together with a number of smaller ones. We witnessed the charging of one of the furnaces and the rolling operations, both hot and cold, right down to the final stamping operation.

Everyone enjoyed the visit to the utmost and we sincerely thank the Ford Motor Company for its hospitality.

R. H. DUDLEY, *Publicity Chairman.*

●

INDIANAPOLIS BRANCH

The meeting at Fox's Steak House at 1315 E. Washington Street on September 4 opened with a steak dinner served to approximately 30 members and guests at 7 P. M.

MR. GEORGE APPLEGATE of the Indiana Manufacturers Association spoke on the proposed Labor Safety Code being set up by the Indiana State Department of Labor and entitled "Safety in Electroplating Operations". He explained that this department had consented to have technical committees established to help formulate reasonable, specific and workable codes although there was no compulsion to do so. He mentioned other safety codes and explained how technical committees had acted in cooperation with the Indiana Manufacturers Association in helping to write them. The effects of an unfair or poorly written code upon the plating industry was emphasized and the recommendation was made that the American Electroplaters' Society in the State of Indiana form a committee of 8 to 10 members to work with the Manufacturers Association in revising the proposed code.

The Secretary reported that the Chicago, Cincinnati and St. Joseph Valley Branches had been asked to select a representative each among member residing in Indiana. The President instructed the Board of Governors to choose six members of the local Branch to serve on this committee. The committee should have representation from job shops as well as large companies and both the technical men and management.

Reports on the National Convention were given by several members who attended.

A committee was appointed to study the selection of a more suitable meeting place consisting of WALTER R. BINAI, W. W. COTHRAN and ED BRUCK.

Three new members were elected.

A motion was passed to hold a Regional Meeting on March 29, 1947, to which the Indianapolis, Cincinnati, Dayton, St. Joseph Valley, Columbus and Chicago Branches are to be invited. This meeting is to last one day and will have Educational Sessions in the morning and afternoon, followed by a Dinner Dance in the evening.

The following committee chairmen were appointed:

General Chairman—CARL MORRIS

Convention site and arrangements—ED BRUCK

Ticket sales and advance registrations——W. W. COTHRAN

Entertainmnent—AL KREISE

Educational Sessions—THOMAS EVANS

Advertising and program—WALTER BINAI

Door prizes—MARVIN CRAWFORD

Toastmaster—RICHARD HENNESSY with REX OYLER as Alternate.

The Secretary-Treasurer resigned and CARL F. NIEHAUS was elected to serve out his term.

THOMAS C. O'NAN, Secretary-Treasurer

Electrochemists to Toronto

The Electrochemical Society will hold its Fall Congress on October 16–19 at Hotel Royal York.

Among the features is a session devoted to "War Time Developments in Electrodeposition" on October 16 at 8:30 P. M. Members of the Toronto Branch AES have been invited to attend.

Other sessions include such subjects as "Rectification and Power Supply for the Electrolytic Industry", "New Plastic Insulation", "Theoretical Electrochemistry", and "New Dry Cells".

At the Acheson Medal Dinner in honor of Dr. H. J. Creighton, the speakers will be President Dr. William C. Moore, Dr. Sherlock Swann, Dr. A. F. C. Cadenhead and the Medalist.

Several plant trips are planned.

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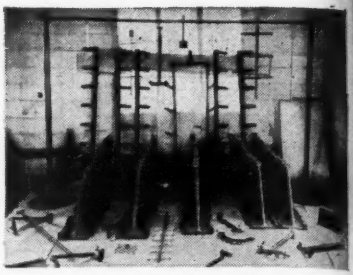

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Consultant, New Britain, Conn.

No. 2,405,592, August 13, 1946—Process of Galvanizing—A. U. Manger and A. H. Ward.

CLAIM 1. The process of galvanizing ferrous metal shapes such as sheets strips and wire which comprises passing the shapes through an atmosphere of ammonium chloride vapors maintained within a temperature range of rom 420° F to 824° F, admitting excess air into ammonium vapor atmosphere, immediately passing the shape from said atmosphere through a galvanizing bath, and controlling the said temperature and admission of air for obviating formation of substantial amount of ferrous chloride on the shapes by reactions of ammonium chloride vapors with the ferrous metal of said shapes.

No. 2,405,776, August 13, 1946—Anode for the Electrolytic Protection of Closed Containers—B. G. Brolinson.

The object of this invention is to provide a novel and improved anode structure wherein a substantial surface area is obtained within the confines of a limited space.

Another object is to provide an anode structure suitable for use in the water head of containers such as condensors, feed water heaters, heat exchangers, boilers and the like, for electrolytic protection.

CLAIM 1. An anode for the electrolytic protection of a container having a water head provided with a housing forming peripheral walls and with a cover adapted to be secured to said housing, said anode comprising a cage structure having a contour conforming in general to the contour of said walls, a pair of insulating members attached to said cover and extending transversely into said head, means attaching said cage to said insulating members whereby said cage is entirely supported by said cover and may be removed therewith, a cross member connecting the free ends of said insulating members, a fixed supporting rod attached to said housing, said rod having means engaging said cross member when said cover and anode are in assembled position to impart rigidity to said structure, said cross member being slidable into or out of engagement with said last means as said head is assembled or removed.

No. 2,405,157, August 6, 1946—Pickling Apparatus—Stanley H. McKee, assignor to Youngstown Welding and Engineering Company.

CLAIM 1. A pickling apparatus for bars, rods, tubes and the like, comprising a tank, flexible slings for suspending a plurality of such pieces to be treated in such tank, and means for diverting said sling without holding such pieces, including a fixed member in said tank presenting an upper horizontal bearing edge adapted to be contacted by said slings, whereby the latter, on being lowered beyond the top of said bearing edge, are caused to fall into loops on each side thereof.

No. 2,405,662, August 13, 1946—Coating —Charles E. McManus, John D. Elder, Giles B. Cooke and Albert J. Dornblatt, assignors to Crown Cork and Seal Company, Inc., Baltimore, Md.

The present invention relates to a method of coating with metallic vapors and is particularly concerned with a novel product such as sheet steel or black iron having a coating of aluminium bonded thereto and articles formed therefrom.

The aluminium coating produced from the vaporized metal is characterized by having a purity greater than that of customary aluminium coatings. The abrasion resistance of the coated metal is satisfactory, but the coating may be oxidized and hardened.

CLAIM 2. A method of coating a metal base with vaporized metal comprising introducing the metal to be coated, prior to coating, into a feeding zone and maintaining the same under reduced pressure therein, continuously introducing the metal from said feeding zone, while maintaining the metal under reduced pressure, into a coating zone with the metal at a temperature below that of the vaporized metal, maintaining the coating zone also under reduced pressure, coating the metal surface on one side as it travels through said zone by vaporizing the coating metal in said coating zone continuously as the metal base travels therethrough and by maintaining a difference in potential between the continuously traveling metal base and the vaporized metal ions to thereby direct the vaporized metal to the metal base and to deposit the vaporized metal upon said side, coating another side of said metal base as it continuously travels from said first zone through a second zone and in the same manner as in said first zone, the second zone also being maintained under reduced pressure, and continuously collecting the coated metal from said second coating zone in a zone maintained under reduced pressure.

CLAIM 4. The method in accordance with Claim 2 wherein the metal base is steel and the vaporized metal for producing the coating on steel is aluminium.

There are several drawings.

No. 2,406,189, August 20, 1946—Method for Tin Plating—Newell F. Blackburn, assignor to E. I. du Pont de Nemours & Co.

In the present commercial practice for electroplating tin, alkaline plating baths containing sodium stannate or potassium stannate are commonly used. Although sodium stannate electroplating baths may be operated satisfactorily at comparatively low current densities, such baths have the disadvantage that when it is desired to operate at high current densities in order to obtain high plating speed, the anode efficiency becomes so low as to make such baths unsatisfactory for commercial operation. Although sodium stannate electroplating baths have been successfully used at current densities up to 50 asf, no method has been available hitherto by which these electroplating baths could be satisfactorily operated at current densities substantially above 50 asf. In the case of potassium stannate electroplating baths, the difficulty encountered in obtaining satisfactory anode efficiencies exist at even lower current densities, and lack of a method for operating such baths at higher current densities has seriously hampered the commercial development of the potassium stannate bath.

I have discovered that when a tin anode containing a relatively small amount of an alkali metal is utilized in the stannate plating bath, a surprising and unexpected increase in anode efficiency is obtained and stannate baths utilizing these novel anodes may be operated at high current densities with high electrode efficiencies.

CLAIM 1. A process for electroplating tin which comprises electrolyzing an aqueous solution of an alkali metal stannate and an alkali metal hydroxide with an alloy anode comprising essentially tin and at least one alkali metal, the total alkali metal content of said anode being 0.1 to 10 per cent by weight.

CLAIM 4. A process for electroplating tin which comprises electrolyzing an aqueous solution of potassium stannate and potassium hydroxide (or sodium stannate and sodium hydroxide) with an alloy anode comprising essentially tin and 0.1 to 10 per cent by weight of potassium (or sodium respectively).

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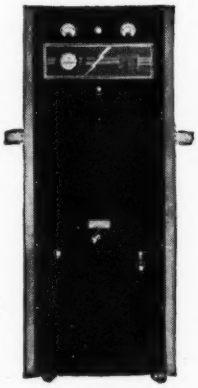


Here is the completely self-contained Rectifier with meters, off-on switch and stepless variable control.

Standard units are designed for 6 volts and 9 volts with current capacity of 500, 1000, 1500 and 2000 amperes.

Combinations also for 12/6 volts, 18/9 volts, 250/500 amperes, 500/1000 amperes. Motor-driven separate remote controls are recommended for 1500 amperes and above.

Standard units can be used in multiple arrangements to obtain 5000 and 10,000 amperes or higher.

Write today for the R-A way—descriptive literature on our complete line of Custom-Built Rectification for your special applications.

Rectifier Divison

RICHARDSON-ALLEN CORPORATION

15 West 20th Street New York 11, N. Y.

INDUSTRY NEWS

POSITION WANTED

Young competent man with two years at the University of California and four years of supervisory experience in hard industrial chromium plating desires, in the San Francisco Bay area, position with definite opportunity for advancement.

Experienced in microscopic analyses, control of plating baths, use of pickles and electrocleaners, application of patented rustproof coatings, and other allied subjects. Familiar with plating of several other metals and some experience in the deposition of tin. Studying labor-management problems. Satisfactory reference can be obtained.

Send replies to MR-10A, THE MONTHLY REVIEW, P. O. Box 168, JENKINTOWN, PA.

Brown Will Stress Performance Angle at Chemical Show

An overall display of modern industrial instruments that have already made performance records in speeding and improving hundreds of chemical and other processes will feature the *Brown Instrument Company*, at the National Chemical Exhibit, September 10 to 14, at Chicago.

The Brown display will point up flow meters, electronic instruments, recording control thermometers, the new adjustable indexet, pressure controllers, pneumatic transmitters and receivers and other new and improved models.

J. A. Robinson, Industrial Manager of the Company's Chicago office, will be in charge of the exhibit in Booths N-34 and 35.

Michigan Bleach and Chemical Co. Now Operating Under New Name

It has been announced that, effective August 1, the Michigan Bleach and Chemical Company, 12345 Schaefer Highway, Detroit 27, Michigan, is operating under the name of Nelson Chemicals Corporation.

This change affects the Company's Cleveland, Ohio, and Windsor, Ontario, affiliates, and it is believed it will lead to smoother inter-organization operations in order to better serve customers in a proposed expansion program.

●

New Wyandotte Leaflet Describes Cleaning Products

A new leaflet has been prepared by *Wyandotte Chemicals Corporation* describing the Company's specialized line of products for maintenance cleaning . . . mopping and scrubbing floors, washing painted surfaces and cleaning porcelain enamel. Advantages of using these Wyandotte Products —*Detergent, F-100, El-Bee Cleaner, 97 Paste and Steri-Chlor*—as well as simple directions are included.

Copies may be obtained by writing *Wyandotte Chemicals Corporation, Wyandotte, Michigan.*

●

Improved Contact Wheels for Abrasive Belt Polishing

No clogging of abrasive belts with increased production and longer belt life are improvements claimed for *Presto Contact Wheels* by *The Manderscheid Company*, 810 Fulton St., Chicago 7, Illinois.

Presto Contact Wheels are made of specially constructed Neoprene rubber vulcanized to a metal core. The tough, resilient rubber affords uniform yielding quality for conffrmation to the work, assuring fast, uniform polishing. Complete freedom from hard spots avoids burning. The patented design snaps the belt as it leaves the work, beating it clean with 72 hammer strokes per revolution of the wheel. The abrasive belt is thereby kept clean and cuts effectively until the abrasive is worn off rather than clogged.

Presto Contact Wheels, 14″ in diameter with 2″, 3″ and 4″ face, are carried in stock. Diameters are precisely uniform and two or more wheels can be used together in forming any desired width.

Three degrees of resiliency, medium, hard and soft are claimed to meet about any condition. Medium is suitable for 90% of polishing jobs. Hard is used for snagging and other coarse grained work. Soft handles plastics and extremely soft metals.

Literature mailed promptly on request to manufacturer.

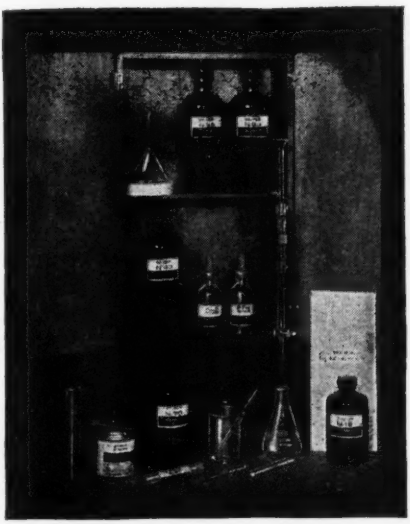
New Continuous Dryer Announced by Optimus

A machine designed to dry loaded racks continuously before or after plating, or after any other type of water-solution dip, has been introduced by the *Optimus Equipment Company*, 131 Church Street, Matawan, N. J., manufacturers of metal washing and drying equipment.

The machine is continuous in its operation, and works almost completely closed. It can be connected to an exhaust blower, so that all fumes can be drawn off. Any heating system, steam, gas, or electricity, can be employed. Drying time is usually from 4 to 6 minutes.

The *Optimus Continuous Cold and Hot Air Dryer* can be used as single-stage dryer or in connection with a number of successive operations, alkaline, acid, or neutral. The manufacturer states that it is most efficient as a stainless dryer, although other uses are practical.

The cold air system includes a blower and a series of nozzles. The hot air system in-



CHROMIUM
NICKEL
COPPER

Simple test sets for aid in controlling plating and other solutions.

Write for literature.

KOCOUR CO.

4725 S. CHRISTIANA AVE.
CHICAGO 32, ILL.

Specify Kocour Sets from your supplier.

cludes an air-heater, re-circulating blower, a damper to adjust the mixture of atmospheric air and re-circulating air, and the necessary nozzles.

●

Charles O. Chesnut Heads Wyandotte Pacific Division

Charles O. Chesnut became General Manager of the newly organized *Pacific Division* of *Wyandotte Chemicals Corporation*, effective August 1. Manufacturing and distributing activities in the Pacific States of the products of both the J. B. Ford and Michigan Alkali Divisions of Wyandotte Chemicals Corporation, and of Natural Soda Products Company, will now be directed from the new Pacific Division office, 502–14 Central Tower Building, San Francisco 3. The Pacific Division will also solicit business on the new Wyandotte organic specialties and fine chemicals.

Mr. Chesnut also became president of *Natural Soda Products Company* August 1 on the retirement of *Stanley Pedder*, who had requested more time to devote to his law practice. The manufacturing operations of this organization are at Owens Lake, California.

Field sales activities of the former J. B. Ford Division (specialized cleaning compounds) will continue to be supervised by *P. S. Spencer*.

Phillips Chemical Company Issues New Cleaning Handbook

The *Phillips Chemical Company*, manufacturers of production line cleaning compounds and industrial maintenance compounds, has announced publication of a new handbook on *Production and Maintenance Cleaning*.

This handbook gives complete information on proper methods and compounds for use in every type of production line cleaning as well as maintenance cleaning. Included are recommendations for alkali cleaners, electrolytic cleaners, emulsion cleaners, paint and enamel removers, rust removers, carbon removers, bright dips, burn off and vapor solvent degreasing.

The handbook is offered free of charge on receipt of request on your company's letterhead. Requests should be sent to Phillips Chemical Company, 3402–30 Touhy Avenue, Chicago 45, Illinois.

●

Two Pennsalt Officials Receive Danish Medals

Two Philadelphians, *Leonard T. Beale*, President of the *Pennsylvania Salt Manufacturing Company*, and *Richard L. Davies*, Assistant to the President of Pennsalt, have received from King Christian X of Denmark the King Christian X Medal of Liberation for their efforts for the Danish cause during the years of Nazi occupation.

Mr. Beale and Mr. Davies became very active in helping Greenland as soon as the Nazis invaded the Danish homeland in April of 1940.

Their activity came about as a result of the long association of the Pennsylvania Salt Manufacturing Company with the Danish government and Danish companies dating from 1865, when Pennsalt entered into its first agreement to import crude cryolite ore which is found in mines near the Greenland port of Ivigtut.

●

Sam Tour & Co. Announce Extension of Facilities

Sam Tour & Co., Inc., Engineers, Metallurgists and Consultants, with offices and laboratories at 44 Trinity Place, New York

6, N. Y., announce an extension of facilities for research and for field service to industry.

Warborn science has greatly extended the field of nondestructive examination as exemplified in two remarkable new instruments, the *Penetron* and the *Probolog*. Thus, it becomes possible with them to examine high pressure pipe lines from the outside for dangerous internal corrosion or erosion, to explore ship hulls and tanks for thinning of walls which may lead to serious loss, and to examine heat exchanger and condenser tubes for detrimental conditions.

●

New Product Announced by Holub Industries

Holub Industries, Inc., Sycamore, Illinois, has announced a new *Combination Safety Test Lamp and Voltage Indicator*.

It is no longer necessary for plant electricians, construction electricians, or motor repair service men to carry two tools, it is stated. The "Hi" Tester is an inexpensive pocket instrument, yet, offers the ultimate in safety, reliability and efficiency. It is equipped with a filament lamp (not neon) and has only one test lead which prevents shorting out the resistor.

The "Hi" Safety Test Lamp and Voltage Indicator is for use on AC or DC Circuits to locate grounds, opens, blown fuses, motors running single phase, tracing control and other circuits, and to indicate approximate voltage. Gives definite signals in brightly lighted as well as in dark places without confusion. No fuses required for safety. Both the lamp and test lead are easily renewed.

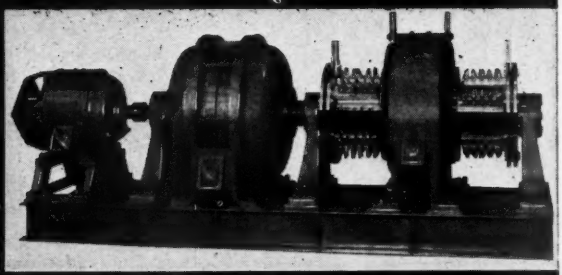
●

Granville M. Read Succeeds Everett Ackart at DuPont

The *Du Pont Company* has announced the retirement of *Everett G. Ackart*, Chief Engineer, and the appointment of *Granville M. Read* to succeed him. Mr. Read has been assistant chief engineer of the company since 1943. The changes became effective September 1.

Mr. Ackart, who climaxed his career by supervising the design and construction of

COLUMBIA MOTOR GENERATORS



FOR ELECTRO-PLATING

Columbia Generators embody every feature essential for dependable, 24-hour operation. They are built for electroplating service in sizes of 6 to 20 volts, 500 to 20,000 amperes, for anodic treatment of aluminum in sizes of 40, 50, and 60 volts, 500 to 3,000 amperes. Columbia Generators for other electrolytic processes range from ½ to 250 KW, 100 to 40,000 amperes, 6 to 60 volts. Write for full information.

COLUMBIA ELECTRIC MFG. CO.

4519 HAMILTON AVE., N.E. CLEVELAND 14, OHIO

Chicago Office — 1525 E. 53rd St.

more than a billion dollars worth of war plants which Du Pont built and operated at the Government's request, has been with the Company almost 40 years. He started with Du Pont in 1907 as a junior engineer assigned to power testing and power-cost checking.

Mr. Read is a Director of the Remington Arms Company, Inc., affiliated with the Du Pont Company, a member of the American Society of Chemical Engineers, and the honor engineering society of Tau Beta Pi.

●

Reynolds Metals Company presents Alloy Selector

A mass of technical information concerning 18 of the most widely used aluminum alloys is presented in easy-to-use form in *Reynolds Aluminum Alloy Selector*, a slide-rule type of chart in standard 8½ x 11 inch size.

The main horizontal slide is pulled to line up with the aluminum alloy under consideration. Then the chart reads directly the chemical composition in per cent for twelve elements and shows physical constants including specific gravity, density, modulus of elasticity in tension and torsion, coefficient of thermal expansion, thermal and electrical conductivity, specific heat. Data are also given on maximum forging temperature, recommended cycles for solution heat treatment and annealing.

Then by moving a second slide vertically to line up with one of seven different product forms (sheet, plate, wire, rod-bar, shapes, tubing-pipe, forgings), the chart shows tempers available in that product form; ranges of tensile strength, yield strength, hardness and elongation; comparable AMS, ASTM, Federal and Navy specifications.

Aluminum alloys covered include 2S, 3S, 14S, 17S, 18S, 24S, Pureclad 24S, 25S, 32S, A51S, 52S, R353, 56S, R361, R301, R303, Clad R303, R317.

In addition, the chart includes an explanation of alloy and temper designations as well as a brief description of outstanding properties of each of the 18 different alloys.

Charts may be purchased from *Reynolds Metals Company*, Department 47, 2500 S. Third Street, Louisville 1, Ky. Price $1.00.

Howard J. Ward Appointed Udylite District Manager

The Udylite Corporation has appointed *Howard J. Ward* District Manager for the Michigan territory.

Mr. Ward has been with the Udylite Corporation for the past ten years, and during the war spent most of his time in Washington with the Army and Navy Engineers on plating problems. He was given a citation from the Navy Department's Chief Maintenance Engineer, Bureau of Aeronautics for meritorious service. Mr. Ward will replace *William H. Ross*, who recently resigned.

●

Wyandotte Issues Leaflet on Boiler Compound

"*What, Why, Where, How*" is the title of a new 8-page leaflet just prepared by *Wyandotte Chemicals Corporation*, listing the advantages of *Wyandotte Boiler Compound* and directions for its use.

This leaflet answers the questions asked in its title, with diagrams, charts and written instructions.

Copies may be obtained by writing *Wyandotte Chemicals Corporation, Wyandotte, Michigan.*

U. S. Rubber Plans Increase In Grinding Wheel Output

United States Rubber Company has announced that plans are being made to triple its production of high-speed grinding wheels used by steel mills, foundries and metal fabricating plants.

Increased production facilities will be established in a new plant in Ft. Wayne, Ind., recently acquired from the government. *J. A. Fairfield*, Manager of Grinding Wheel Sales, said the Company will increase the volume and variety of both rubber and synthetic resin bonded wheels.

Other products to be made in Ft. Wayne will include industrial adhesives, rubber-covered rolls, rubber-lined tanks and pipes.

●

Allegheny Ludlum Steel Consolidates Divisions

Consolidation of Sales development and engineering service divisions of *Allegheny Ludlum Steel Corporation*, under the managership of *W. B. Pierce*, has been announced.

Functions of the new department will be to coordinate and extend the Company's cooperation with users and fabricators o stainless steel on their problems of applica tions and uses. Special attention will be given to the development of new markets for new alloys.

●

Du Pont Relinquishes Atom Work to General Electric

Walter S. Carpenter, Jr., President of *E. I. Du Pont de Nemours and Company*, stated on August 30, "The Du Pont Company, this week, finishes an exacting task which the War Department assigned us almost four years ago."

Mr. Carpenter was referring to the fact that at midnight, Saturday, August 31, the Du Pont Con pany turned over to the General Electric Company all of the duties and activities in the performance of its contract with the government in its atomic energy program. At that time, General Electric assumed operation of the Hanford Engineer Works at Richland, Wash.

When Du Pont, in the fall of 1942, acceded to the government's request that it design, construct, and operate the plant for the production of plutonium, the Company

FOR SALE Available for Immediate Shipment

2—15,000/7500 AMPERE, 6/12 VOLT, **COLUMBIA ELECTRIC CO.** Motor Generator Sets. Separately Excited. Full Control Equipment. Write for full details.
2—5000/2500 AMPERE, 6/12 VOLT, **COLUMBIA ELECTRIC CO.** Motor Generator Sets. Separately Excited. Excellent Condition. Full Control Equipment.
1—5000/2500 AMPERE, 6/12 VOLT, **EAGER ELECTRIC COMPANY** Motor Generator Set. Separately Excited. Excellent Condition. Full Control Equipment.
1—4000/2000 AMPERE, 3/6 VOLT, **HANSON & VAN WINKLE CO.** Motor Generator Set. Separately Excited. Excellent Condition. Full Control Equipment.
1—3000/1500 AMPERE, 6/12 VOLT, **BENNETT & O'CONNELL CO.** Motor Generator Set. Separately Excited. Excellent Condition. Full Control Equipment.
1—2500/1250 AMPERE, 6/12 VOLT, **HANSON & VAN WINKLE CO.** Motor Generator Set. Separately Excited. Full Control Equipment. Excellent Condition.
1—2000/1000 AMPERE, 6/12 VOLT, **CONNECTICUT DYNAMO AND MOTOR CO.** Motor Generator Set. Excellent Condition. Full Control Equipment.
1—1500/750 AMPERE, 6/12 VOLT, **IMPROVED AMERICAN GIANT** Motor Generator Set. INTERPOLE CONSTRUCTION. D.C. Motor. Excellent Condition. Full Control Equipment.
1—1500/750 AMPERE, 6/12 VOLT, **HANSON & VAN WINKLE CO.** Motor Generator Set. Excellent Condition. Full Control Equipment.
1—1000/500 AMPERE, 6/12 VOLT, **CHANDEYSSON ELECTRIC CO.** Motor Generator Set. Full Control Equipment. Excellent Condition.
2—1000/500 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING CO.** Motor Generator Sets. Full Control Equipment. Excellent Condition.
3—1000/500 AMPERE, 6/12 VOLT, **CHARLES J. BOGUE ELECTRIC CO.** Motor Generator Sets. Separately Excited. Full Control Equipment.

ANODIZING MOTOR GENERATOR SETS

1—1000 AMPERE, 50 VOLT, **CHANDEYSSON ELECTRIC CO.** SYNCHRONOUS-DRIVEN Anodizing Motor Generator Set, complete with Exciter and Full Controlling Equipment.
2—500 AMPERE, 40 VOLT, **MOTOR GENERATOR CORPORATION** Anodizing Motor Generator Sets. Excellent Condition. Full Controlling Equipment.
1—500 AMPERE, 24 VOLT, **HANSON & VAN WINKLE CO.** (INTERPOLE TYPE) Motor Generator Set. Excellent Condition. Full Controlling Equipment.
1—**HANSON-VAN WINKLE-MUNNING CO.** SEMI-AUTOMATIC CONVEYOR OUTFIT—For Copper Plating. 24 ft. x 4 ft. x 3 ft.

M. E. BAKER COMPANY 143 SIDNEY STREET CAMBRIDGE, MASS.

asked that it be relieved of the task as soon as practicable. Further, it was stipulated that all patent rights would be the property of the government.

●

J. C. Leonard Appointed Oakite Sales Manager

Announcement is made by *Oakite Products, Inc.*, New York, of the appointment of *J. C. Leonard* as Sales Manager of its Industrial Marketing Division.

Associated with the Oakite organization in the servicing of its specialized cleaning materials and equipment for over 22 years, the last 16 years of which was in the capacity of Manager of the Company's Chicago Division, Mr. Leonard assumed his new duties on September 1, 1946. He will direct the marketing and servicing activities of Oakite's Industrial Field Staff from the general offices of the company in New York.

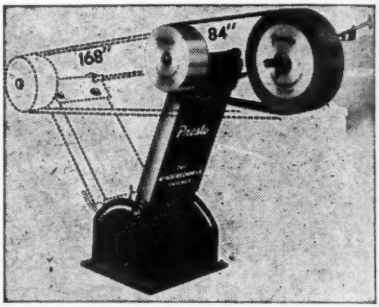
●

Wagner Brothers Open New Plant and Warehouse

Wagner Brothers, suppliers to the metal finishing industries, have announced the opening of their new plant and warehouse at 400 Midland Ave., Detroit, Michigan. Besides increased space for their stock of buffing, polishing and plating materials and equipment, the new quarters will house a complete analytical laboratory and modern pilot metal finishing set-up.

Wagner Brothers offer these facilities for customers' use in solving their daily production problems as well as for the thorough testing of new materials, methods and equipment.

●



Manderscheid Offers New Improved Back-stand Idler

Quick change to any belt length isprovided in a new *Presto Back-Stand Idler* recently announced by *The Manderscheid Company*, 810 Fulton Street, Chicago 7, Illinois.

It is claimed that the *Back-Stand Idler* can be adjusted for any belt length from 84″ to 168″ in 30 seconds or less. It is of all steel construction with double sealed ball bearings. Leaf type springs afford adjustable tension. Snubber action eliminates vibration and belts run smoothly. The aluminum pulley is perfectly balanced and is easily changed from right hand to left hand operation.

Literature will be mailed promptly on request to the Company.

●

Michael Donovan Joins Turco Products Staff

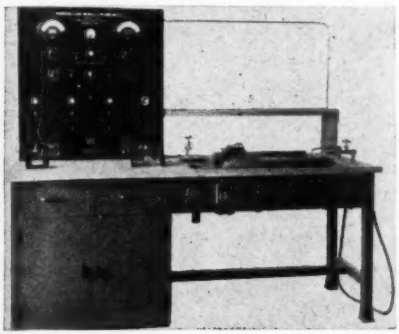
Turco Products, Inc., Los Angeles, Chicago, and Houston, makers of industrial chemical products, has announced the appointment of *Michael Donovan* to the Technical Service Staff.

Mr. Donovan's services at Turco Products will be devoted to the solution of mainte-

nance problems in every industrial field. He is located at the Los Angeles office and is available for consultation at all times.

•

H-VW-M Develops New Diggin Control Table



The Hanson-Van Winkle-Munning Company, Matawan, New Jersey, announces the development of the *Diggin Electroplating Control Table*, a complete miniature plating laboratory designed for either routine control of plating solutions or the most exacting research work on electroplating problems and processes. Outstanding advance was made in electroplating a few decades ago when analytical control of plating solutions began to supplant rule-of-thumb methods. However, it is known today that correct analysis alone cannot insure quality of deposits, especially with modern high current density bright-plating processes. Chemical analyses must be supplemented by controlled plating tests. Together with analysis these tests will enable corrective measures to be taken that will eliminate defective deposits.

With this new scientific control instrument, the Control Table, test panels can be plated under closely controlled conditions so that the results of additions, impurity removal treatments and variations in operating conditions can be observed. Only a few hundred milliliters of electrolyte are required to conduct these tests.

Full information on the Diggin Electroplating Control Table can be obtained on request from the Hanson-Van Winkle-Munning Company, Matawan, New Jersey.

For Sale

•

Slightly Used
BUFFS

LOOSE & SEWED
ANY QUANTITY
ALL SIZES

•

Michigan Buff Co., Inc.
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DETROIT (7) MICHIGAN

•

McKeon's

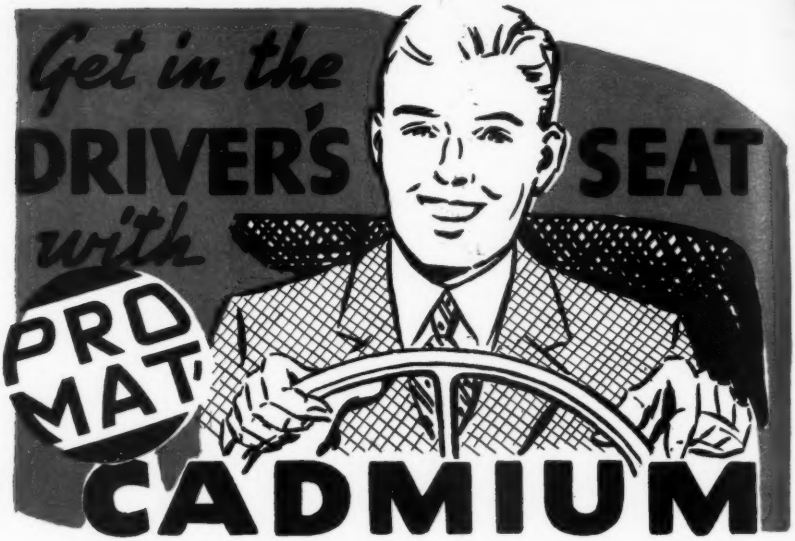
"Liquid Sulphur"
TRADE MARK REG'D
for stripping copper and oxidizing copper and silver.

Zinc-Brite
TRADE MARK REG'D
Brightens "ailing" zinc solutions.

Tin-Strip
Strips tin (no etch). Simple, fool-proof, inexpensive.

(Individual difficulties our specialty)

SULPHUR PRODUCTS CO.
Greensburg 9, Pa.



You're "Out in Front" and heading in the right direction with Promat Cadmium additions in your plating bath. Promat gives new high standards of speed, quality and color in cadmium plating. For barrel or racked work—for use from 5 to 50 amperes per square foot—for deposit rates as high as 3/10,000 in four minutes—5/10,000 in eight minutes, etc. Promat produces the most brilliant cadmium you have ever seen.

CONVERT TO PROMAT

Purify your bath by activated carbon filtration and adjust to the approximate following formula: Sodium cyanide 12.5 ounces per gallon, cadmium as metal 3.5 ounces per gallon. Then add: 80 cc. per gallon Promat C-28-S basic addition and 36 cc. per gallon Promat C-50-S brightener. Total cost per gallon: less than 15c. Extremely nominal maintenance costs. Additions available in 12 gallon carboys. Concentrated prepared electrolytes and maintenance solution available if desired. For extreme high speed, where fast handling methods are available, the Promat Kicker Unit further broadens the plating range of the Cadmium bath. Don't take a back seat, but keep in the "Driver's Seat" with Promat Cadmium.

Send some of your parts for sample plating. Write for further information or contact your distributor. Distributors:

WAGNER BROTHERS
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W. D. MACDERMID CHEMICAL CO.
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BART-MESSING EQUIPMENT CO., INC.
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ELECTRO-PROCESS EQUIPMENT & SUPPLY CO.
St. Louis
CROWN RHEOSTAT & SUPPLY COMPANY
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851 SOUTH MARKET STREET **WAUKEGAN, ILLINOIS**

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ADELAIDE, AUSTRALIA. Acting Secretary G. N. Dixon, G. P. O. Box 428D, Adelaide, Australia.

BALTIMORE-WASHINGTON meets first Tuesday of each month, in October, December, February and April at the Engineers' Club, Baltimore, Md, and in November, January, March and May at Kenesaw Apts, Washington, D. C. Secretary-Treasurer, L. G. Tubbs, 7011 Kenleigh Road., Baltimore 12, Md.

BOSTON meets first Thursday each month at Hotel Statler, Boston, Mass. Secretary, Dr. George P. Swift, 53 Galen St., Watertown 72, Mass.

BRIDGEPORT meets first and third Friday of each month at Barnum Hotel. Secretary-Treasurer, Joseph G. Sterling, 134 Colony Street, Bridgeport 8, Conn.

BUFFALO meets second Friday of each month at Hotel Statler, Buffalo, N. Y. Secretary, J. A. Kushner, 316 Winslow Avenue, Buffalo 11, N. Y.

CHICAGO meets second Friday of each month at 8 P. M., at Atlantic Hotel. Secretary, M. H. Longfield, 1528 S. 61st Avenue, Cicero 50, Ill.

CINCINNATI meets on second Wednesday of each month at 8 P. M., at the Engineering Society Headquarters, McMillan Street and Woodburn Avenue, Cincinnati, Ohio. Secretary-Treasurer, Charles Nuzum, Schaible Co., Summer St., Cincinnati 4, Ohio.

CLEVELAND meets first Saturday of each month at Cleveland Hotel. Secretary-Treasurer, Ernest V. Collins, 12436 Tuscora Avenue, Cleveland 8, Ohio.

COLUMBUS meets first Friday of each month at the Battelle Memorial Institute Auditorium, 505 King Avenue, Columbus 1, Ohio, at 8 P. M. Secretary, David S. Stoker, 1338 Meadow Road, Columbus 8, Ohio.

DAYTON meets second Friday of each month at the Engineers Club, Dayton, Ohio. Secretary-Treasurer, Ralph L. Clinefelter, 365 W. Hayes St., West Milton, Ohio.

DETROIT meets the first Friday of each month at the Hotel Statler. Secretary-Treasurer, F. L. Clifton, 16536 Inverness, Detroit 21, Mich.

GRAND RAPIDS meets second Friday of each month, 7:30 P. M., at the Rowe Hotel. Secretary, R. Perkins, 916 Fairmount Street, S. E., Grand Rapids 6, Mich.

HARTFORD meets third Monday of each month at Hotel Garde, Hartford, Conn. Secretary, F. W. Smith, 46 Cottage Street, Meriden, Conn.

BRANCH DIRECTORY

(*Continued from preceding page*)

INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 Washington Street. Secretary-Treasurer, Carl Niehaus, 937 N. Capitol Ave., Indianapolis, Ind.

JACKSON-LANSING meets second Tuesday of each month at the Home Dairy Co. in Lansing. Secretary-Treasurer, U. J. Forsyth, 1816 Ada St., Lansing 10, Mich.

LANCASTER meets second Friday of each month at 8 P. M., at Thaddeus Stevens Industrial School, Lancaster, Pa. Secretary-Treasurer, H. Clay Brubaker, 881 Manor Street, Lancaster, Pa.

LOS ANGELES meets second Monday of each month, at 6:30 P. M., at Hotel Cabrillo, 11th and Broadway. Secretary-Treasurer, E. R. Holman, P. O. Box 2649, Terminal Annex, Los Angeles 54, Calif.

MELBOURNE, AUSTRALIA. Secretary, L. A. Francis, G. P. O. Box 4502.

MILWAUKEE meets first Friday of each month at the Red Arrow Club, 774 N. Broadway. Secretary-Treasurer, James Durnford, 2370 N. 32nd Street, Milwaukee 10, Wis.

MONTREAL meets second Monday of each month at Mount Royal Hotel, Montreal, Quebec, Canada. Secretary-Treasurer, William L. Glover, 754 Second Avenue, Verdun 19, Quebec, Canada.

NEWARK meets first and third Friday of each month at Hotel Robert Treat, Newark, N. J., at 8 P. M. Secretary-Treasurer, George Wagner, 1130 S. Long Avenue, Hillside, N. J.

NEW HAVEN meets second Tuesday of each month alternating between Sterling Chemistry Laboratory, Yale University, and Hotel Taft. Secretary-Treasurer, B. J. Gaffney, 40 Filbert Street, Spring Glen, Hamden 14, Conn.

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(Continued from preceding page)

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INDEX TO ADVERTISERS

A

Alsop Engineering Corp. 1025
American Brass Company 1043
American Electroplaters' Society 1046, 1054, 1055

B

Baker Company, M. E. 1117
Blakeslee & Co., G. S. 1123

C

Ceilcote Company, The 1094
Columbia Electric Mfg. Co. 1115
Crane Equipment & Supply Co. . 1108

D

Darco Coporation 1027
Divine Brothers 1068
Du Pont de Nemours Co., Inc. 1018, 1019

E

Egyptian Lacquer Mfg. Co. 1029
Enthone Company 1022

G

General Chemical Co. 1101
General Electric Co. 1026
Gumm Chemical Co., Frederick . . . . . Second Cover

H

Hammond Machinery Builders, Inc. 1069, 1094
Hanson-Van Winkle-Munning Company 1070, 1071
Harrison & Company 1111
Hay Company, Jacob 1072
Heatbath Corporation 1030

I

Industrial Filter & Pump Co. 1033
Industrial Lining Eng., Inc. 1108

K

Kirk & Blum Mfg. Co. 1068
Kocour Company 1113

L

Lasalco, Inc. 1021
Lea Mfg. Company . . . . . Back Cover
L'Hommedieu & Sons Co. 1031

M

Maas & Waldstein Co. 1038
MacDermid, Inc. . . . . Third Cover
Magnus Chemical Company 1034
Magnuson Products Corp. 1072
McGean Chemical, The 1032
Meaker Company, The 1023
Michigan Buff Company 1119

N

Nankervis Company 1024
Nelson Chemicals Corporation . . . 1028

O

Oakite Products, Inc. 1015
Optimus Equipment Co. 1042

P

Promat Div., Poor & Co. 1120
Puritan Mfg. Co., The 1035

R

Richardson-Allen Corp. 1111

Seeley Company, E. E. 1069
Seymour Mfg. Company, The 1067
Sparkler Mfg. Co. 1036
Stevens Co., Frederic B. 1016
Storts Welding Company 1102
Sulphur Products Co. 1119

U

Udylite Corporation 1124
United Chromium, Inc. 1020, 1066
U. S. Government 1126
U. S. Stoneware Co. 1088

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